SAM SERVICE
MANUAL

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WAVETEK® RF PRODUCTS, INC.
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4/89

SAM SERVICE & TRAINING MANUAL

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SAM SERVICE AND TRAINING MANUAL

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Thanks

To all the technicians, calibrators, assemblers and ex-circle members who gave their time and ideas to make this manual possible.

Special Thanks

To Terri Eicks, Pat Smith, and Donna Watson who devoted a lot of time and special effort into helping the Circle publish this manual.

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Always check battery check on meter before returning unit for repair.

Charge the battery for 16 hours after 8 hours of use.

Only experienced RF technicians should attempt to troubleshoot the RF module.

CAUTION

Nickel cadmium batteries build up a memory.

Example

If the battery is continually used for two hours then charged, the battery will maintain only a two hour charge.

The microprocessor board in the SAM III and IV is static sensitive.

CAUTION

SAM IV units run from line voltage. Discharge the SAM IV high voltage supply before going into the unit.

Make sure power is off when working on all types of Sams!!!

Sams are delicate instruments and should be treated with care

ADVISED TEST EQUIPMENT

1. MC 50 Signal Generator.
2. 1801 Sweep/Signal Generator.
3. CM1000 Frequency Counter
4. Oscilloscope.
5. Volt/Ohm Meter.
6. Pick Off Loop.
    a) A Pick Off Loop is made by soldering a piece of solid buss wire to one side of a open end F connector, and bending it into a four turn coil soldering the other end to the center of the connector.

ADVISEMENT:

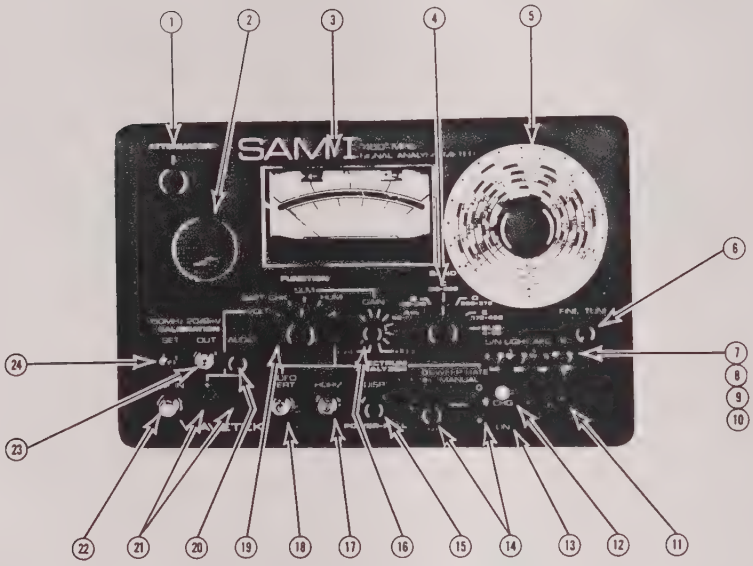
All schematics and reference designations are subject to change without notice.

INTRODUCTION

The SAM I is a very popular meter, due primarily to its excellent accuracy and reliability. The IF is designed with ceramic filters to eliminate coils that can shake loose and change tuning. Frequency tuning in the SAM I is accomplished with a five band calibrated dial and a band selector switch. The clear labeling technique on the front panel makes channel selection very easy. An important feature of the SAM I is the built-in calibrator. This 150MHz signal is provided at the front panel at +20 dBmV. This permits you to calibrate the meter at the temperature you're working, with the jumper cable you will be using for the test.

The SAM I is available in 4 to 300MHz, 4 to 450MHz, and is also available in the UHF range with either the 300MHz or the 450MHz version. The mechanical design of this unit was considered at every step in the design of this meter.

MODEL SAM I FRONT PANEL

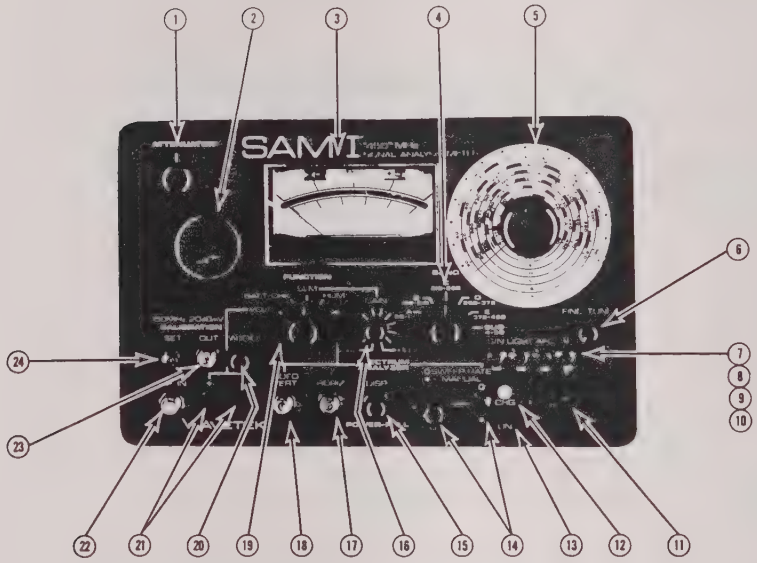


ITEM	DESCRIPTION	PART NUMBER
1	Attenuator Knob	2410-01-0039
2	Speaker Grill	1410-01-1960
3	Meter Bezel	2410-08-0010
4	Bandswitch Knob	2410-01-0039
5	Course Tune Knob	2410-01-0042
6	Fine Tune Knob	2410-01-0034
7	UHF/VHF Switch Option	5106-00-0022
8	AFC Switch	5106-00-0021
9	Light Switch	5106-00-0021
10	Signal to Noise Switch	5106-00-0020
11	AC Receptacle	2112-32-0006
12	Charge Light	2410-01-0007
13	On LED	4810-02-0007
14	a)Sweep Rate/Manual Knob	2410-02-0040
	b)Sweep Rate/Manual Switch	4610-40-4106
15	DISP/Power Knob	2410-01-0035
16	Gain Knob	2410-01-0035
17	Horizontal Barrel Connector	2110-06-1006
18	Video/Vertical Connector	2110-06-1005
19	Function Switch Knob	2410-01-0039
20	Audio Knob	2410-01-0034
21	Banana Jack a) Positive	2112-01-0005
	b) Negative	2112-01-0006
22	RF In Connector	2110-00-0001
23	Calibration Out Connector	2110-06-1005
24	Calibration Set Control	4610-14-8253

SPECIFICATIONS FOR MODEL SAM I

SIZE	7" high x 11" wide x 10" deep
WEIGHT	11 lbs.
BATTERY	Rechargeable Nickle Cadmium Typically have 8 hours, continuous operation.
AC POWER REQUIREMENTS Charging only	110 VAC ± 10% (220 VAC ± 10% optional); 50 to 60 Hz; 20 W
AMPLITUDE RANGE	-40 to +60 dBmV
AMPLITUDE ACCURACY	± .5 dB
TEMPERATURE RANGE	0 to 120° F
TEMPERATURE ACCURACY	± 1 dB
FREQUENCY RANGES	4 to 300 MHz 4 to 450 MHz 470 to 890 MHz
SELECTIVITY	Sufficient to distinguish between two FM signals of equal amplitude 400 kHz apart. Sufficient to measure an audio carrier in the presence of an upper channel video carrier 40 dB greater in amplitude.
I.F. BANDWIDTH	280 kHz at 3 dB, 600 kHz at 40 dB point
HUM	0.5% to 5%
CALIBRATOR	
Frequency	150 MHz ±2 MHz
Amplitude	+20 dBmV ±.25 dB over temperature range
VOLTMETER	5 - 100 AC-DC 10%
SPECTRUM ANALYZER	
Amplitude Range	40 dB on screen; -40 dBmV to +60 dBmV
Frequency Range	4 MHz to 300 MHz or 4 MHz to 450 MHz
Rate	Variable 2 Hz to 40 Hz, plus manual.
Dispersion	Variable from .15 MHz
Horizontal	+.5 to +9V
Vertical	0-3V
S/N	@63 MHz ± 1 dB from 21.6 dB (factory test with calibrated noise source spec)
PEAK DETECTOR	-.2 dB
AFC	Amplitude of signal must pull up from at least 5 dB down to within -.5 dBmV

OPERATOR CONTROLS FOR MODEL SAM I



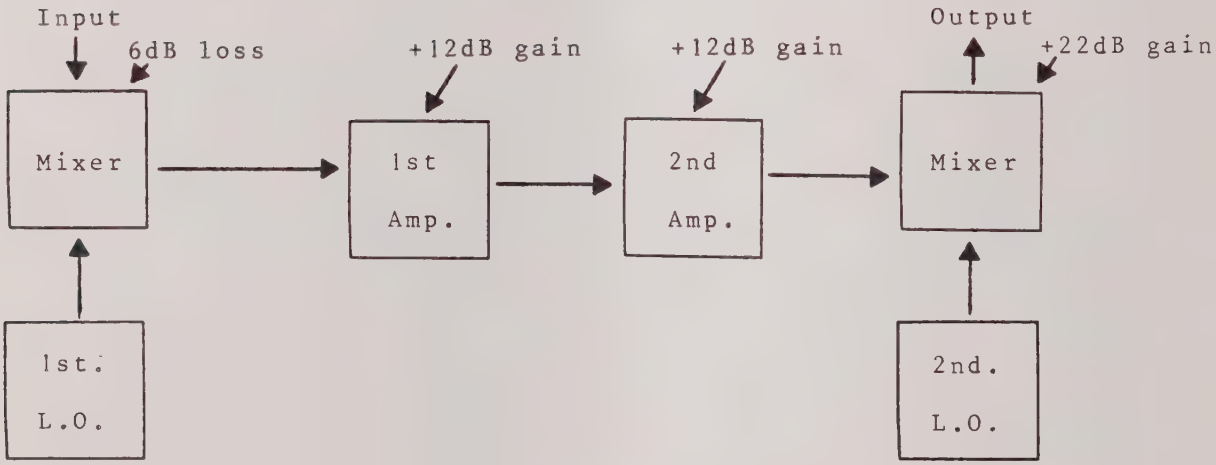
1	ATTENUATOR CONTROL	selects the RF input level range and meter scale to be read.
2	SPEAKER	gives audio output of demodulated signal.
3	METER	indicates value of function being measured.
4	BAND SWITCH	selects tuning control frequency range.
5	TUNING CONTROL	selects the frequency to be measured.
6	FINE TUNE CONTROL	provides fine adjustments for tuning control setting.
7	S/N SWITCH	enables internal compensation for 4 MHz bandwidth noise measurements.
8	LIGHT SWITCH	provides backlighting for the meter.
9	AFC SWITCH	enables the internal AFC circuit.
10	U/V SWITCH	selects UHF or VHF frequency range when UHF option is installed.
11	AC LINE CONNECTOR	provides connection to AC mains via three-conductor line cord.
12	CHARGE LAMP	indicates the internal battery is being charged.
13	ON LAMP	indicates operation of the instrument.

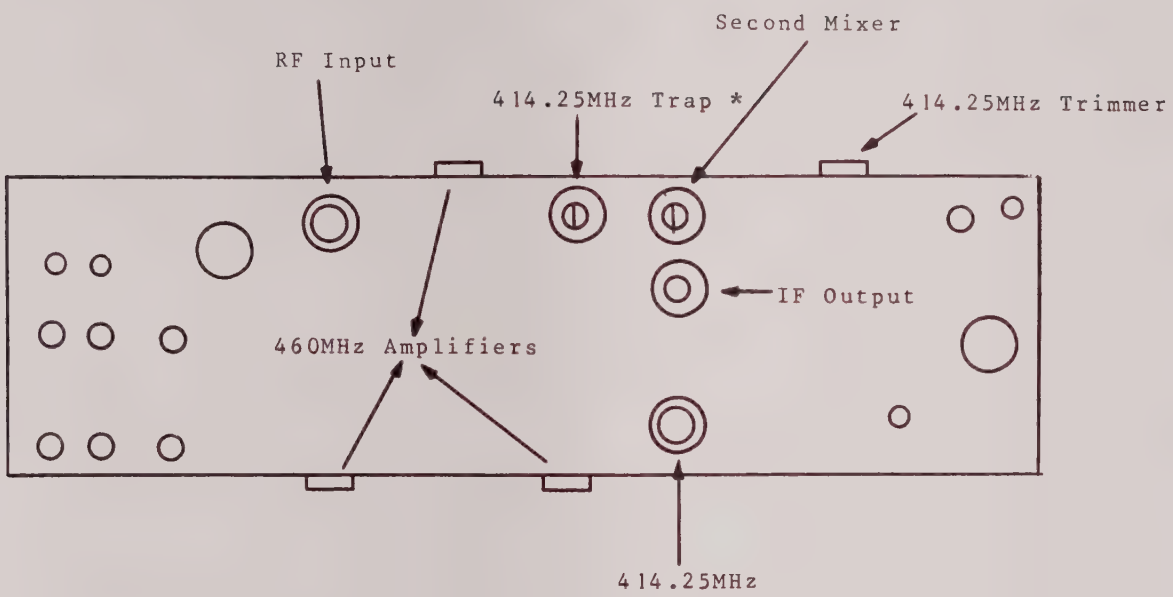
14	SWP RATE/MANUAL SWITCH	selects between sweep and manual modes of the spectrum analyzer when the spectrum analyzer option is installed. The control selects the analyzer sweep or manual rate.
15	DIS/POWER CONTROL	applies DC power to the instrument when pulled out, and selects the spectrum analyzer dispersion when the spectrum analyzer option is installed.
16	GAIN CONTROL	provides 0 to 10 dB of level adjustment when the function switch is set to SLM (signal level meter mode).
17	HORIZ. CONNECTOR	provides the analyzer horizontal output for an oscilloscope when the spectrum analyzer option is installed.
18	VIDEO/VERT CONNECTOR	provides connection for the video output signal and the analyzer vertical output for oscilloscope when the spectrum analyzer option is installed.
19	FUNCTION SWITCH	selects the function to be measured.
20	AUDIO CONTROL	enables the internal audio circuit and adjusts the volume of the speaker output.
21	+/- CONNECTORS	accept test leads for voltage measurements when the function switch is set to volts.
22	RF IN CONNECTOR	provides input for the signal to be measured.
23	CALIBRATION OUT CONNECTOR	provides output from the internal calibrator to calibrate the meter for amplitude measurements.
24	CALIBRATION SET CONTROL	calibrates the meter for amplitude measurements.

R F ASSEMBLY

The R.F. assembly is a frequency converter which converts all tuning ranges of the SAM to a common output of 45.75MHz. The R.F. consists of a 1st L.O. which uses varactor tuning to feed the mixer with the incoming signal. The output of the mixer is 460MHz. Two stages of I.F. amplification follow the mixer with about +12 dB of gain each. This amplified 460MHz signal is then fed to another mixer circuit which is coupled to the 2nd L.O. (414.25) for a common output frequency of 45.75MHz and is connected to the input of the main board I.F.

Some units have UHF coverage by using a added UHF tuning board (1st L.O.). Also, the 2nd L.O. may be crystal controlled, rather than the standard tuneable oscillator.





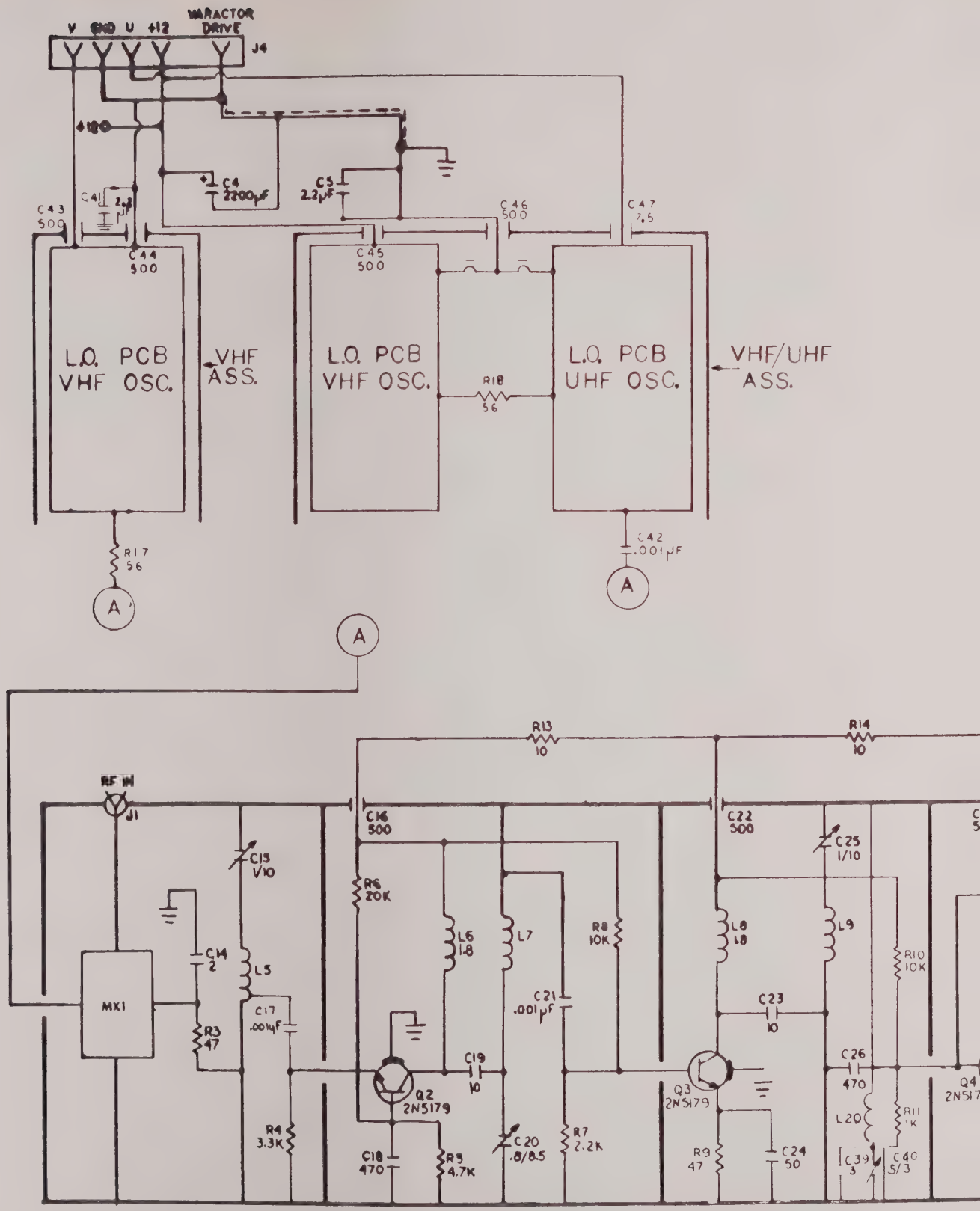
*This trimmer is used to adjust a 414.25MHz trap. This trap keeps the 2nd L.O. signal from feeding back into the IF which could cause a spur to occur at 414.25MHz. Only adjust this trimmer if the Sam indicates a signal at 414.25MHz, when no signal is applied to the Sam "RF in" connector on the front panel.

RF SPECIFICATIONS

TYPE	GAIN	SWEEP WIDTH
Jr. 300	+36 dB - +40 dB	-12 - 310 MHz
Jr. 400	+36 dB - +40 dB	-12 - 410 MHz
Jr. 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
Jr. 450	+36 dB - +40 dB	-12 - 460 MHz
I 300	+36 dB - +40 dB	-12 - 310 MHz
I 400	+36 dB - +40 dB	-12 - 410 MHz
I450	+36 dB - +40 dB	-12 - 460 MHz
I 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
I 450 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
II 300	+36 dB - +40 dB	-12 - 310 MHz
II 400	+36 dB - +40 dB	-12 - 410 MHz
II 450	+36 dB - +40 dB	-12 - 460 MHz
II 300	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
III 450	+36 dB - +40 dB	-12 - 460 MHz
III UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
IV 450	+36dB - +40 dB	-12 - 460 MHz
IV UHF	VHF +36dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz

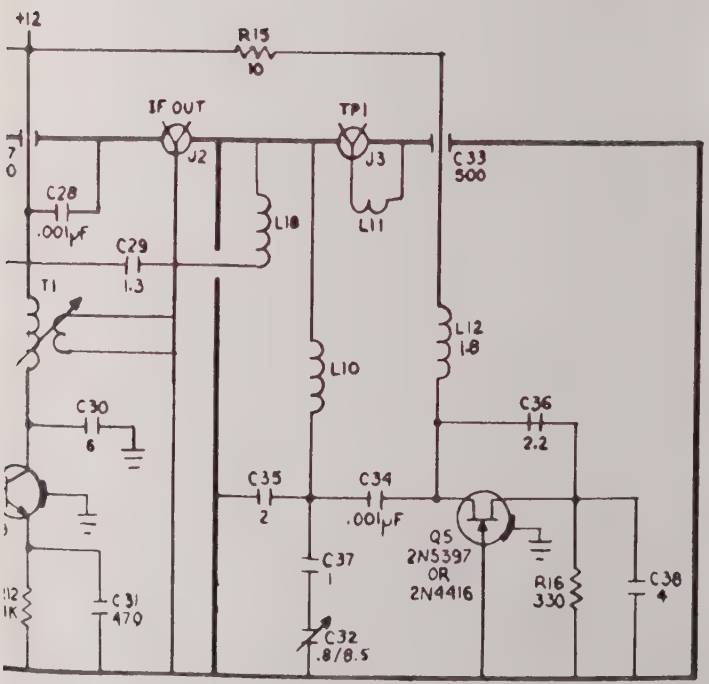
NOTE

All of these RF specifications will include units with the analyzer option.


V GND U +12
VARACTOR DRIVE
J4
+12V
C4 2200µF
C5 2.2µF
C41 2pF
C43 500
C44 500
C45 500
C46 500
C47 7.5
L.O. PCB VHF OSC.
VHF ASS.
L.O. PCB VHF OSC.
R18 56
L.O. PCB UHF OSC.
VHF/UHF ASS.
R17 56
C42 .001µF
A
A
A
RF IN
J1
MX1
C13 V10
C14 2
L5
C17 .001µF
R3 47
R4 3.3K
C16 500
R6 20K
L6 1.8
L7
R8 10K
C21 .001µF
C19 10
Q2 2N5179
C18 470
R5 4.7K
C20 .8/8.5
R7 2.2K
R13 10
R14 10
C22 500
L8 1.8
Q3 2N5179
R9 47
C24 50
C25 1/10
L9
R10 10K
C23 10
C26 470
L20
R11 1K
C39 3
C40 5/3
Q4 2N5179

I450VHF/UHF 0414-30-0030B
RF Assy13

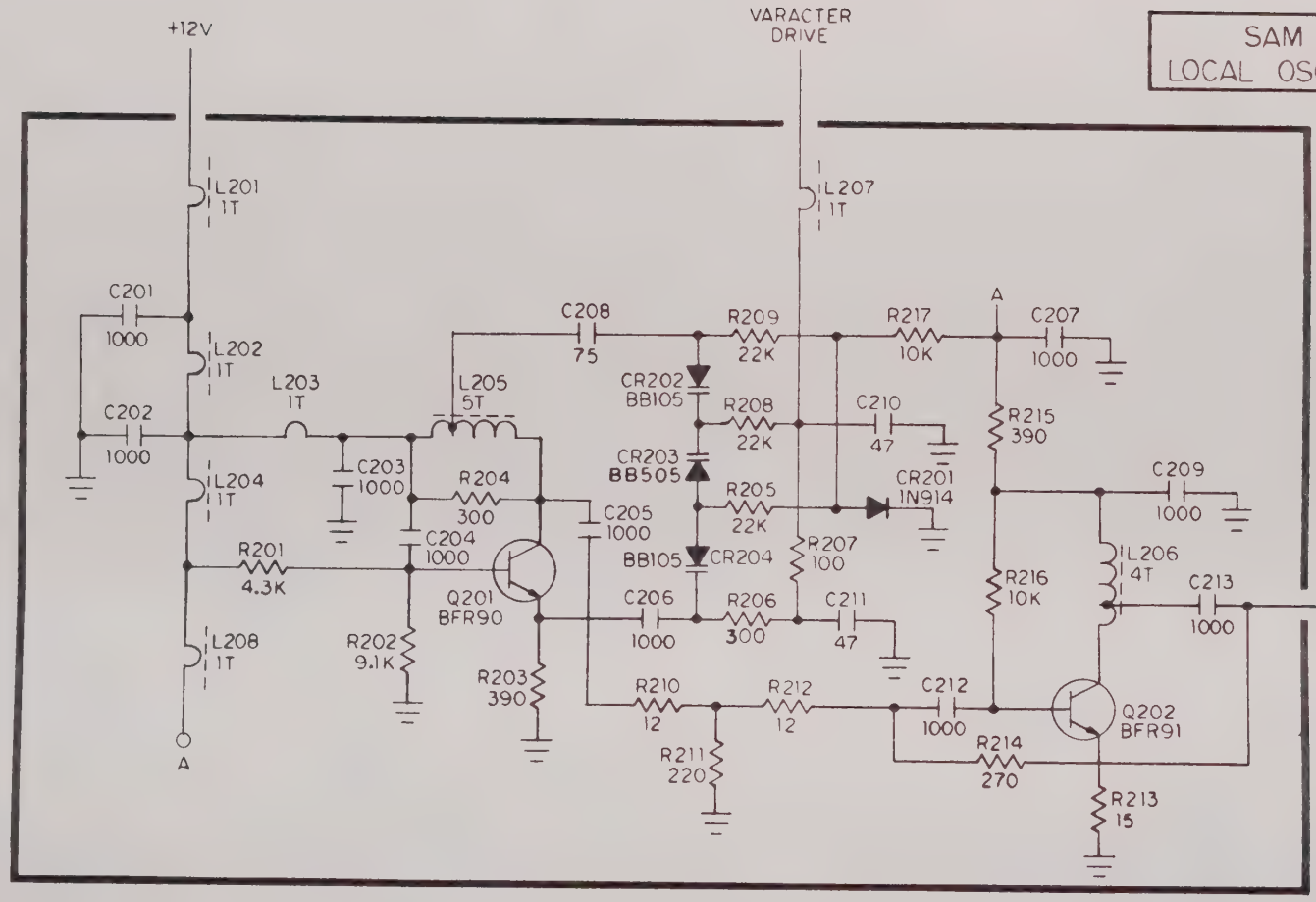
SAM I VHF/UHF – 450
RF ASSY



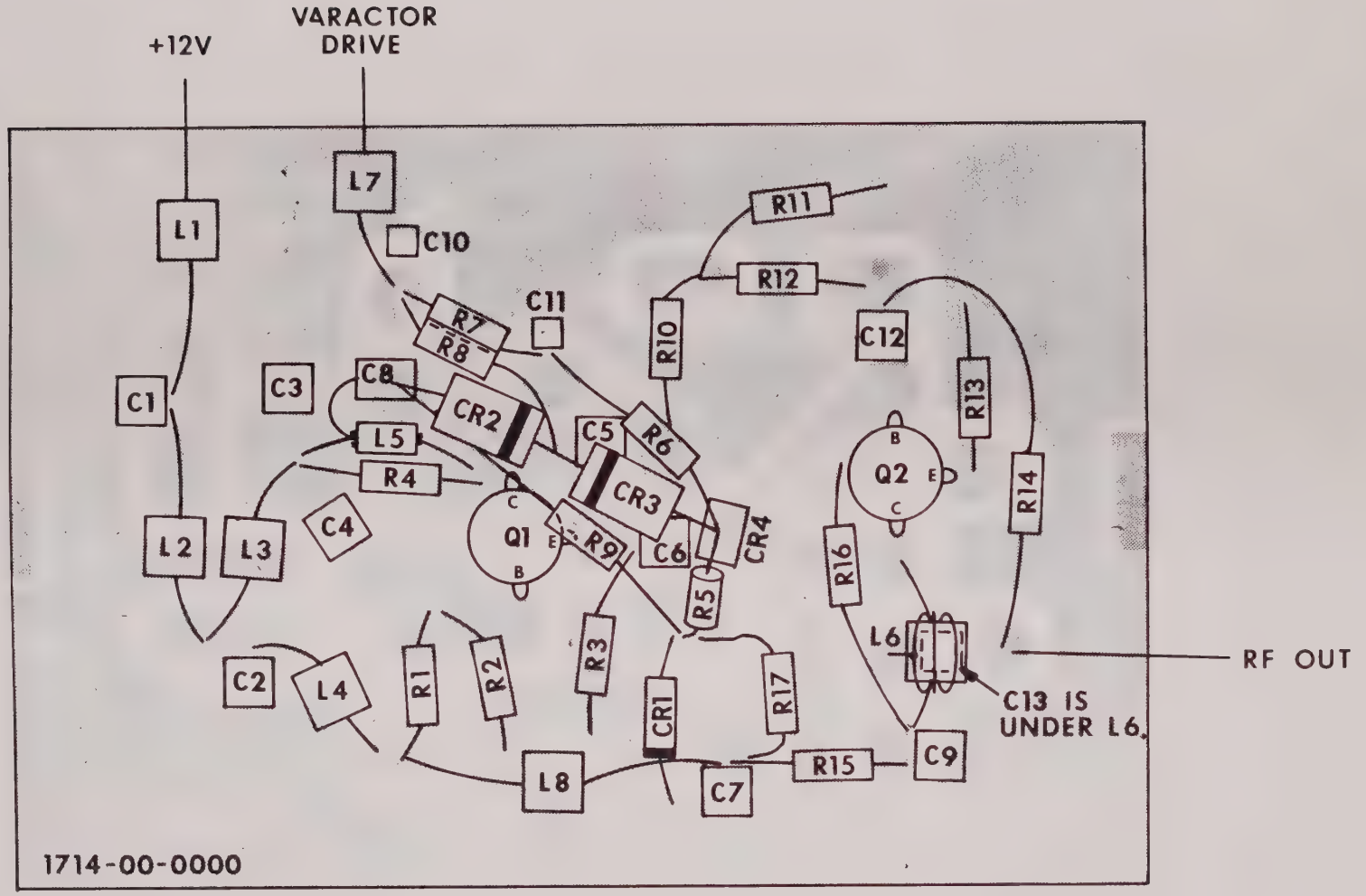
REVISIONS			WAVETEK
	ECN'S	BY	
A	D-1082	TJM	SAM I-450 VHF/UHF RF ASSY
B			
C			DRAWN BY: — DATE: 2-6-82
D			APP'D:
E			0414 30 0030

SAM 1ST LOCAL OSCILLATOR

REV. D



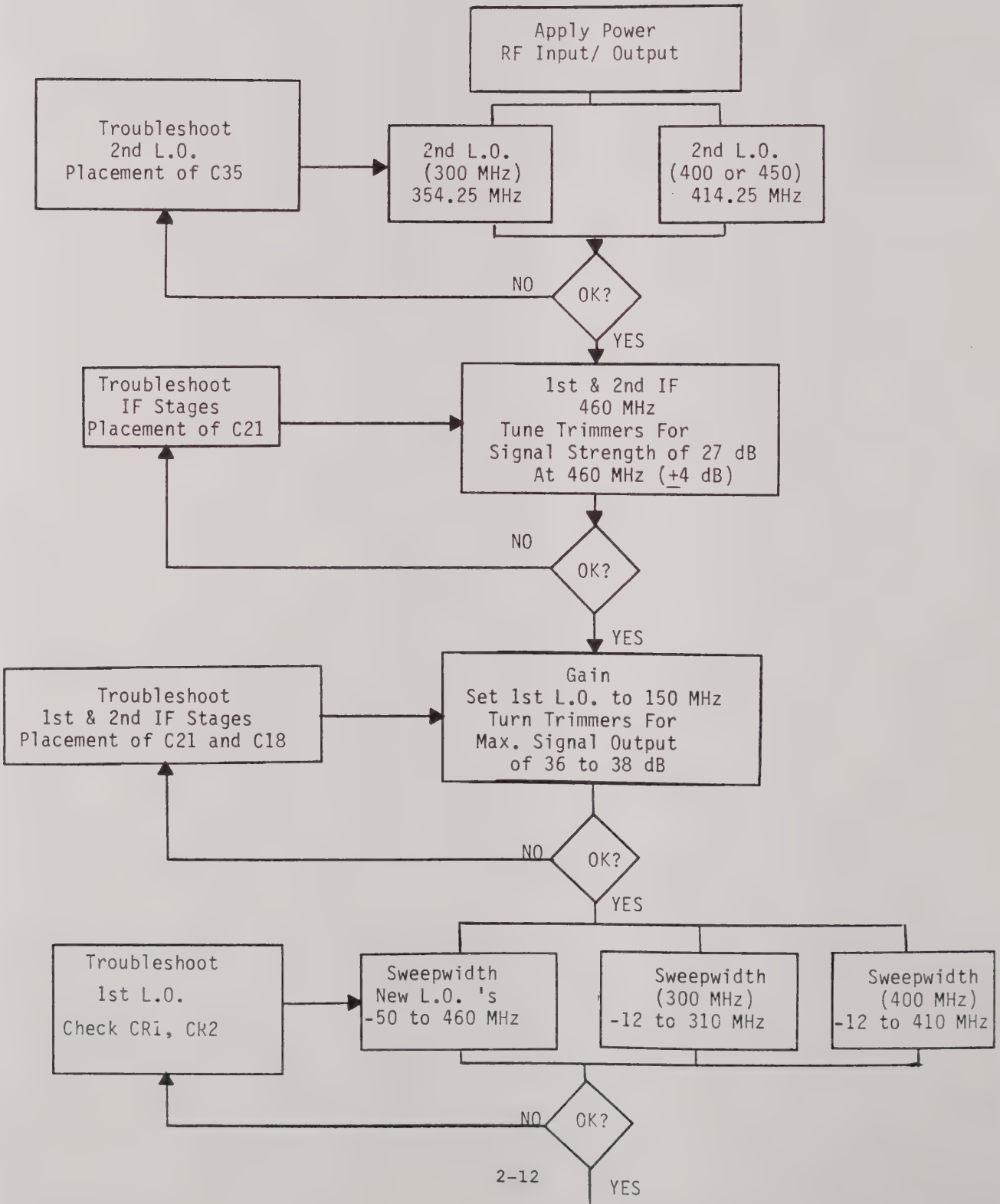
REVISIONS			WAVETEK
	ECN'S	BY	
A	D 018	J.E	SAM 1ST LOCAL OSCILLATOR
B	C034	G.L.R	
C	D-09[illegible]	W.P.	DRAWN BY / DATE / NUMBER
D	D-1021	WP	D. J. WATSON / 3-10-82 / 0414-10-0001
E			APP'D

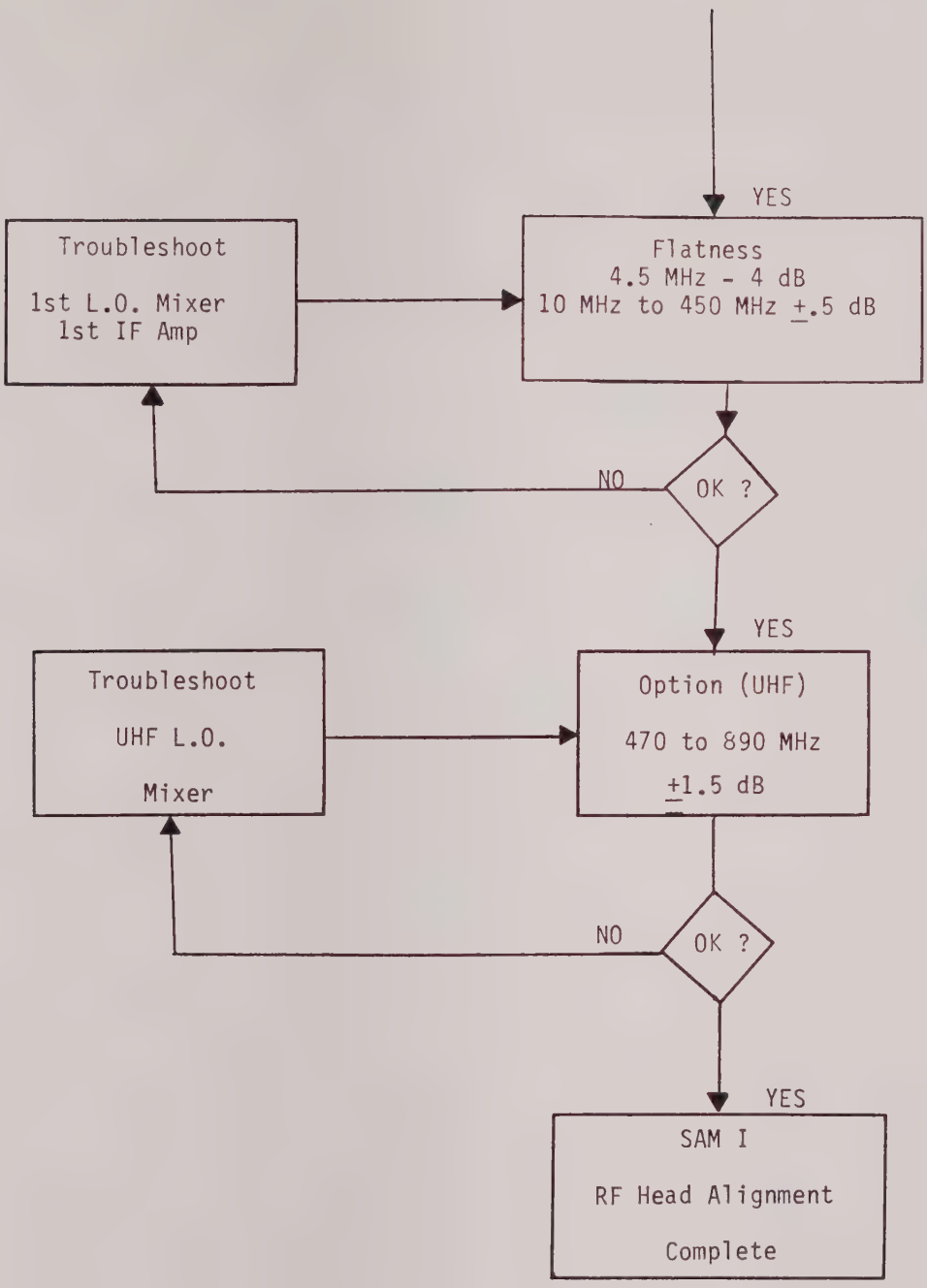


ALL REF. DES. ARE 200 SERIES

SAM I RF HEAD ALIGNMENT

(Generalized)




YES
Troubleshoot
1st L.O. Mixer
1st IF Amp
Flatness
4.5 MHz - 4 dB
10 MHz to 450 MHz ±.5 dB
NO
OK ?
YES
Troubleshoot
UHF L.O.
Mixer
Option (UHF)
470 to 890 MHz
±1.5 dB
NO
OK ?
YES
SAM I
RF Head Alignment
Complete

RF TROUBLESHOOTING

Before taking voltage readings in the RF itself, be sure proper voltages are being supplied to the RF.

There is 12 V supplied to the oscillator board along with varactor drive 0 to 12 volts for tuning.

The first IF amp. transistor is a 5179 and should read approximately 1.6 volts on the emitter, 2.4 volts on the base, and 12 volts on the collector.

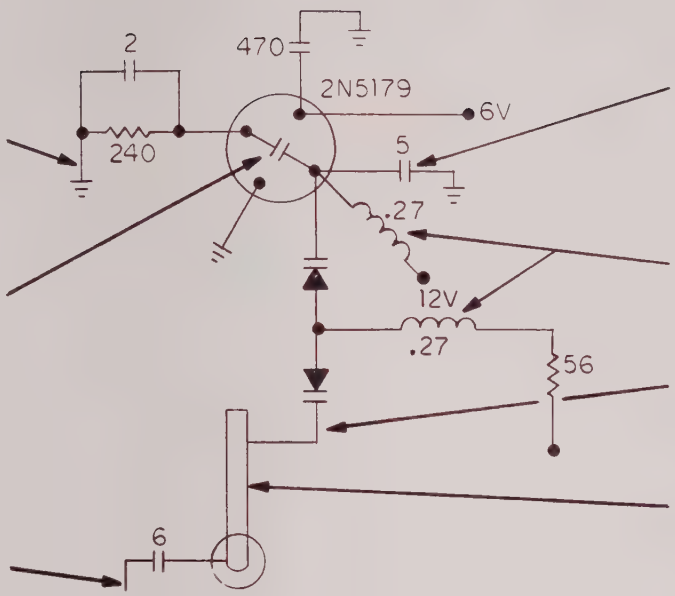
The second IF amp. transistor is also a 5179 which is coupled to the first amp. stage by its base and should read 2.2 volts, 1.3 volts for the emitter and 12 volts for the collector.

In the output mixer stage, a 5179 transistor is used. There should be 1.07 volts on the base which is connected to the 2nd amp. stage by a 470 pf. cap. The emitter should read .3 to .7 volts. The collector is supplied by 12 volts.

The second L.O. (not crystal controlled) uses a 4416 transistor. There should be 12 volts on the collector and 1.5 volts on the base.

If all voltages in the RF are correct, but it still does not meet gain, sweep, or flatness specs, the SAM should be returned to Wavetek for repair and calibration.

SAM 300 1st L.O.



3A. Move grounded end to help sweep.

2A. To increase sweep change to 2.2 pf. To lower sweep change to 1.3 or 1.5 mud cap.

7A. Raising and lowering 6 pf. will help gain at 4.5 MHz.

6A. Change the position of the sweep cap to increase sweep.

1A. Change .27 chokes to to 1.8 to help sweep.

4A. To raise top end range cut off some varactor lead.

5A. Raise frequency by lowering inductor. Lower frequency by raising inductor.

SWEEP

1B Be sure the red cap (470pf) is soldered close to the transistor or the signal will drop off on the high end.

2B If signal drops off before 300 MHz, try replacing the feedback cap 2pf with 1.3 or 1.5 mud caps, if you have plenty of sweep.

3B Changing the position of the emitter cap and resistor will also change frequency range.

4B Be sure the varactor voltage is correct before changing the varactors.

5B For best results, the main tuning inductor should be parallel with the bottom.

6B. Changing the position of the sweep cap can help increase sweep and improve linearity.

NOTE

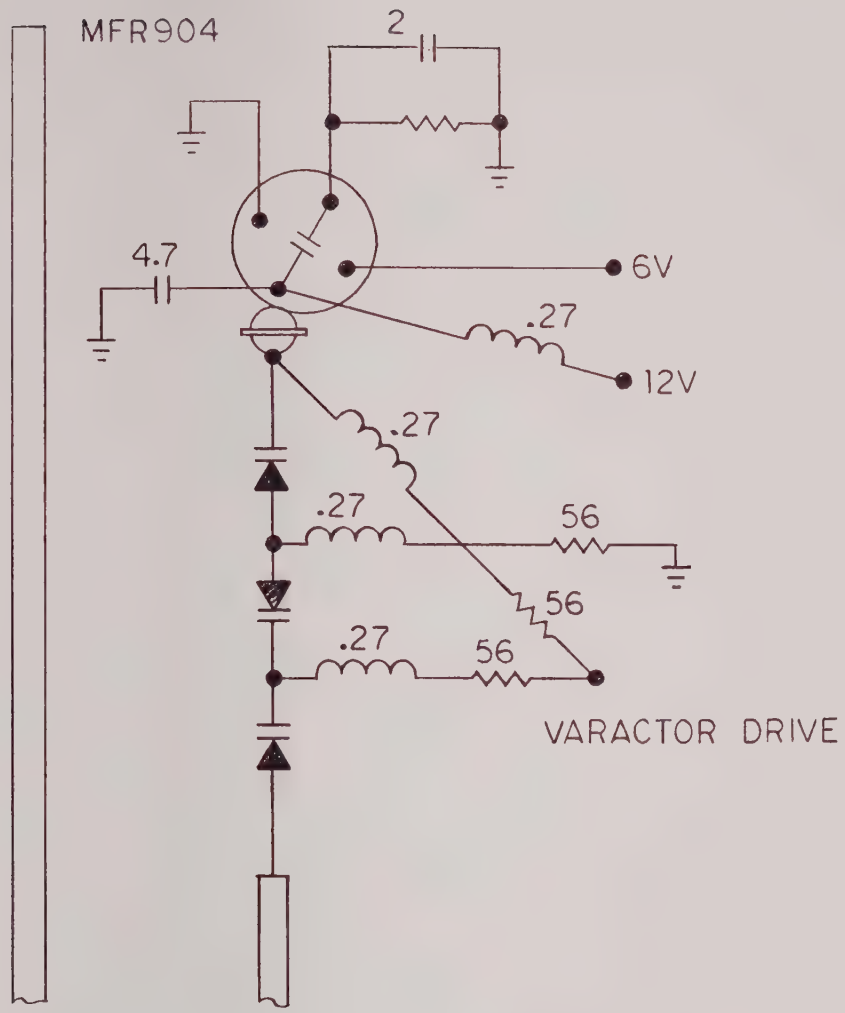
By leaving the L.O. as close to the original construction, it will help sweep width, flatness, and linearity. Remove any solder blobs and long lengths of leads.

FLATNESS

7B Adjust the 6pf for best low end flatness by moving it around for best results, also shortening the leads of the 6pf will help.

7C To help flatness at 4.5 MHz, resolder the tuning inductor higher up where it connects with the 6pf.

7D If flatness is still a problem at 4.5 MHz, remove the 2pf cap at the mixer input.



Low end flatness can be helped by changing the pick-off loop cap to a different value.

A 2pf on the mixer output will help flatness.

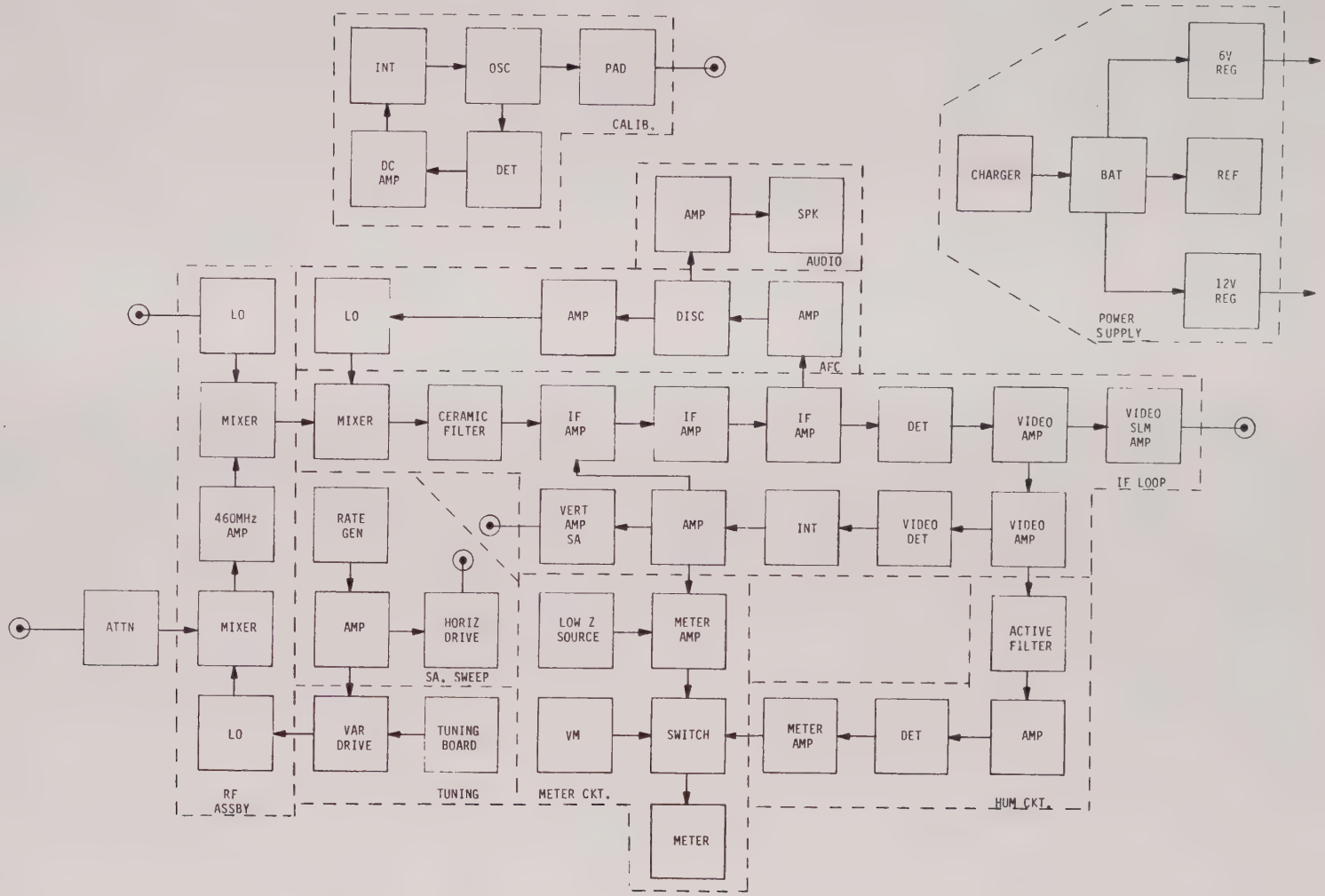
Signal drops off at 300mHz or above, try checking the chip cap for cold solder or not being grounded.

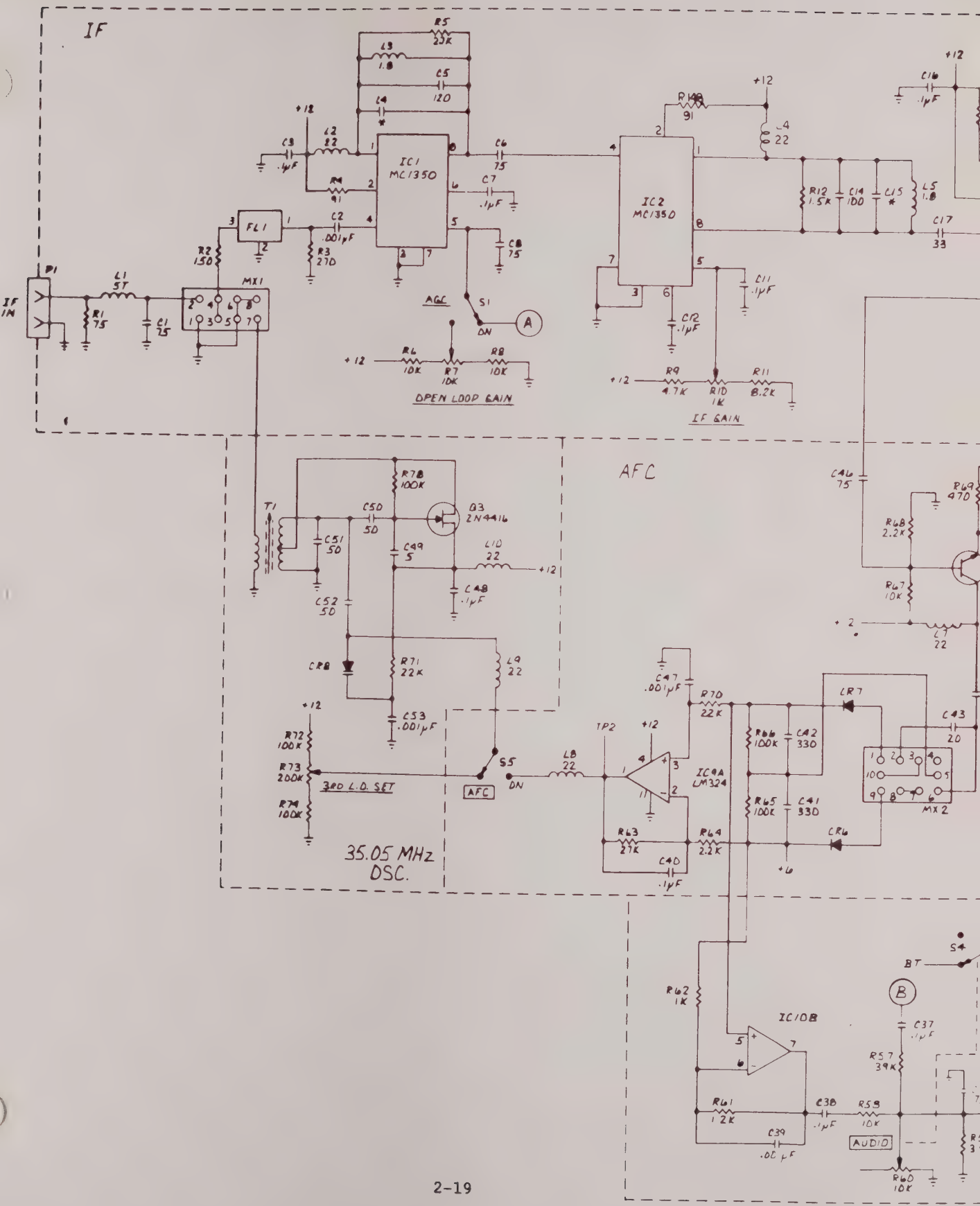
You can find a bad varactor by placing a good one in parallel with it and watch for signal on the scope.

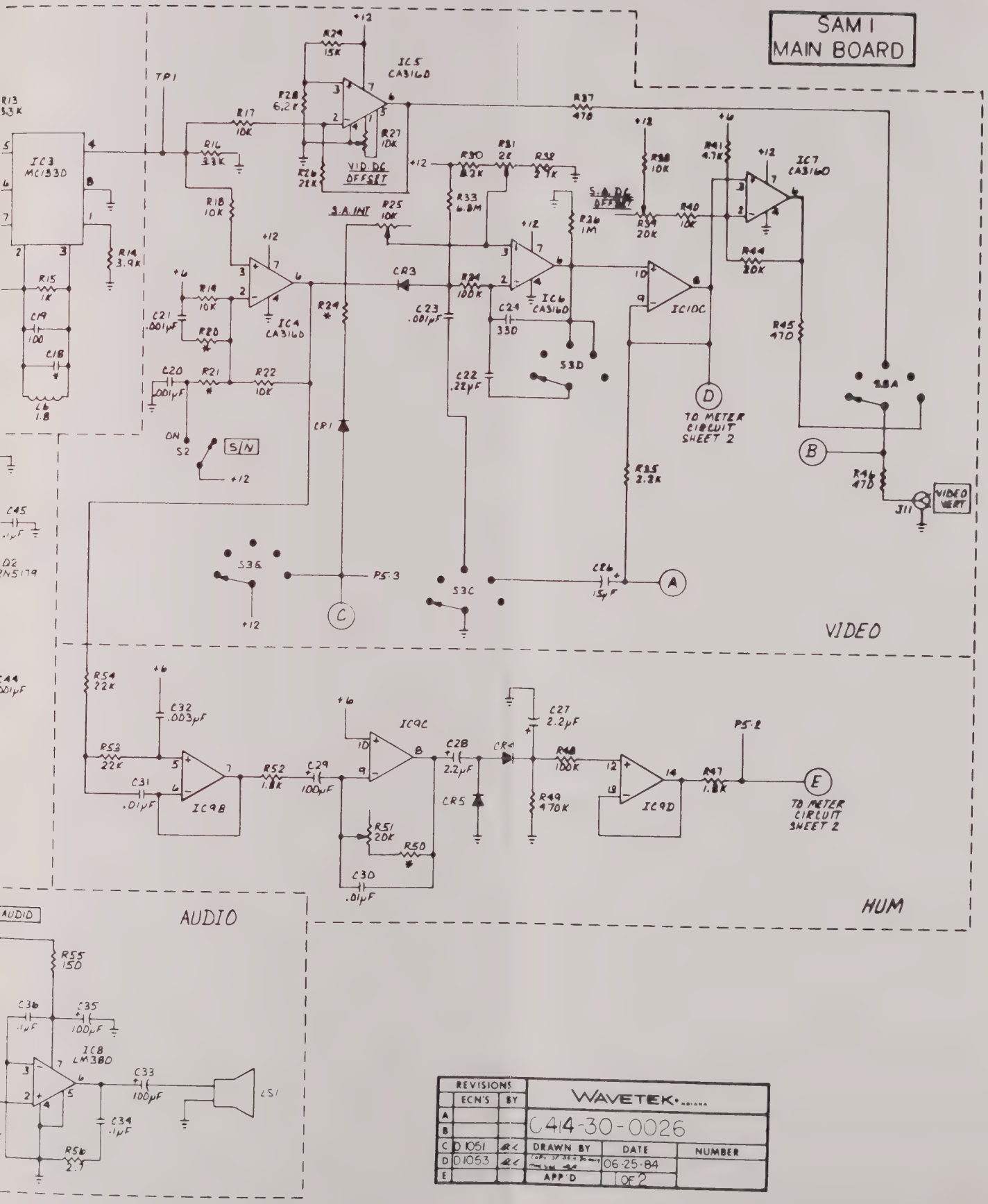
If all else fails, change 1st L.O. transistor to help flatness on the high end.

If signal looks bad on the high end, a bad chip cap, may be the problem.

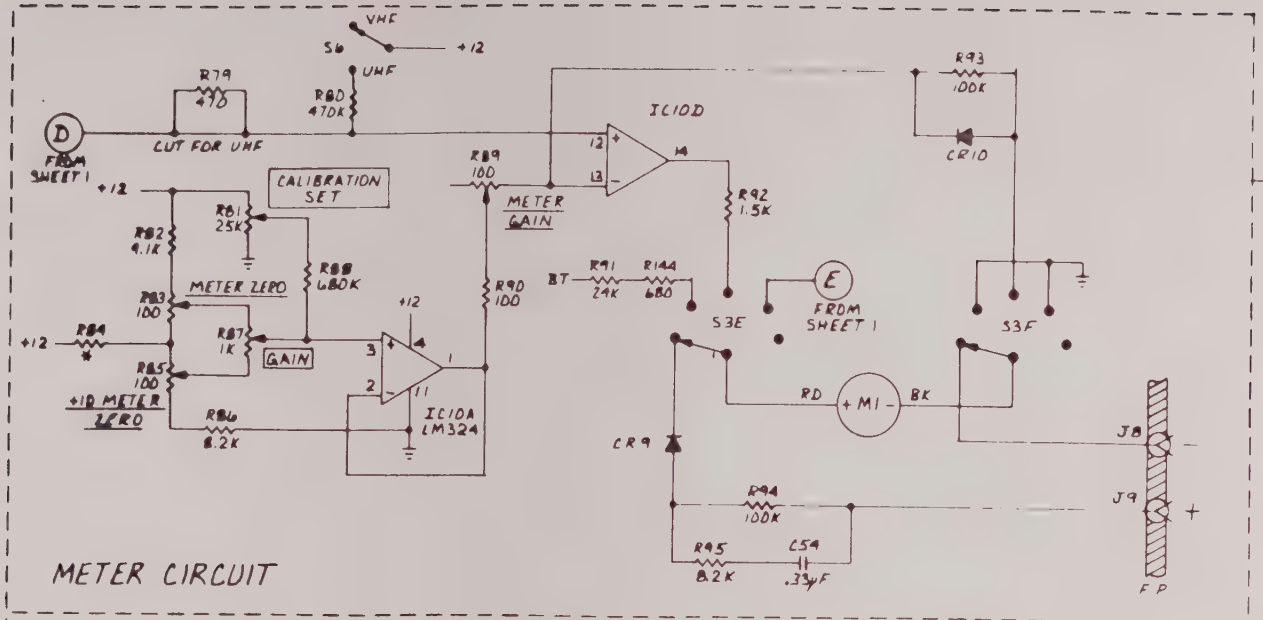
SAM I

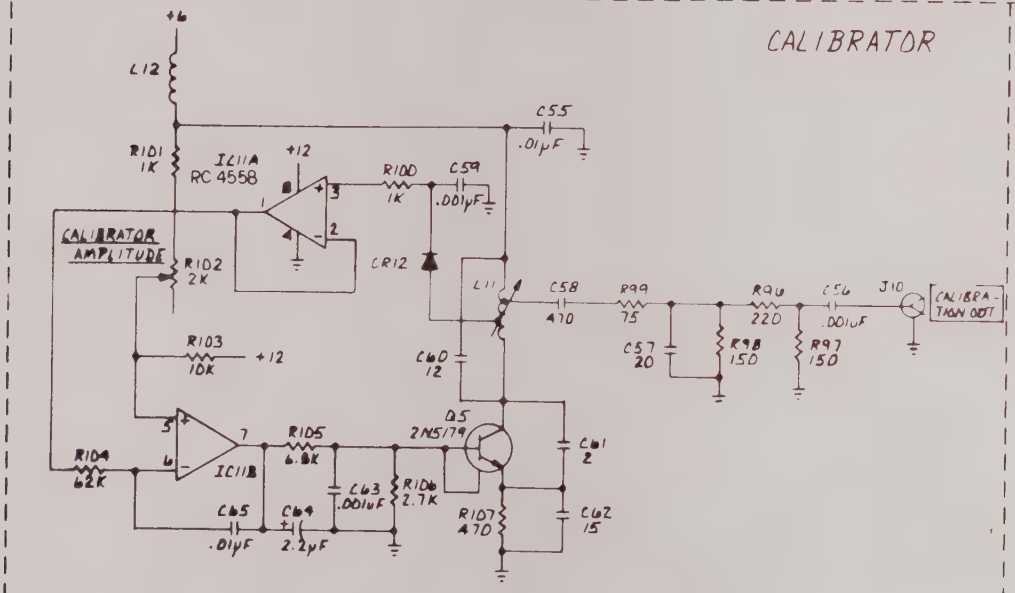

INT
OSC
PAD
CALIB.
DC AMP
DET
AMP
SPK
AUDIO
6V REG
CHARGER
BAT
REF
12V REG
POWER SUPPLY
LO
LO
AMP
DISC
AMP
AFC
MIXER
MIXER
CERAMIC FILTER
IF AMP
IF AMP
IF AMP
DET
VIDEO AMP
VIDEO SLM AMP
IF LOOP
460MHz AMP
RATE GEN
VERT AMP SA
AMP
INT
VIDEO DET
VIDEO AMP
ATTN
MIXER
AMP
HORIZ DRIVE
SA. SWEEP
LOW Z SOURCE
METER AMP
ACTIVE FILTER
LO
VAR DRIVE
TUNING BOARD
VM
SWITCH
METER AMP
DET
AMP
RF ASSBY
TUNING
METER CKT.
HUM CKT.
METER

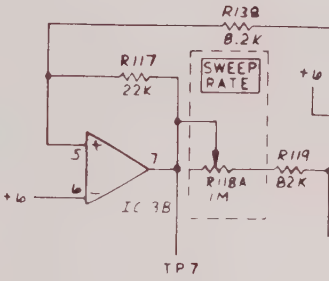

IF
IF IN
P1
L1 .5T
R1 75
C1 75
MX1
FL1
C2 .001μF
R2 150
R3 270
C3 .1μF
L2 .82
R4 91
L3 1.8
C5 120
L4 *
R5 25K
IC1 MC1350
C6 75
C7 .1μF
C8 75
+12
AGC
S1
DN
A
R6 10K
R7 10K
R8 10K
OPEN LOOP GAIN
IC2 MC1350
R10 91
L4 22
C16 .1μF
R12 1.5K
C14 100
C15 *
L5 1.8
C17 33
C11 .1μF
C12 .1μF
R9 4.7K
R10 1K
R11 8.2K
IF GAIN
AFC
T1
R78 100K
C50 50
Q3 2N4416
C51 50
C49 5
L10 22
C48 .1μF
C52 50
CR8
R71 22K
L9 22
C53 .001μF
R72 100K
R73 200K
R74 100K
3RD L.O. SET
S5
AFC
DN
L8 22
35.05 MHz
OSC.
TP2
IC9A LM324
C47 .001μF
R70 22K
R66 100K
C42 330
R65 100K
C41 330
R63 27K
R64 2.2K
C40 .1μF
CR7
CR6
C43 20
MX2
C46 75
R69 470
R68 2.2K
R67 10K
L7 22
+6
S4
BT
B
R62 1K
IC10B
C37 .1μF
R57 39K
R61 1.2K
C38 .1μF
C39 .02μF
R58 10K
AUDIO
R60 10K



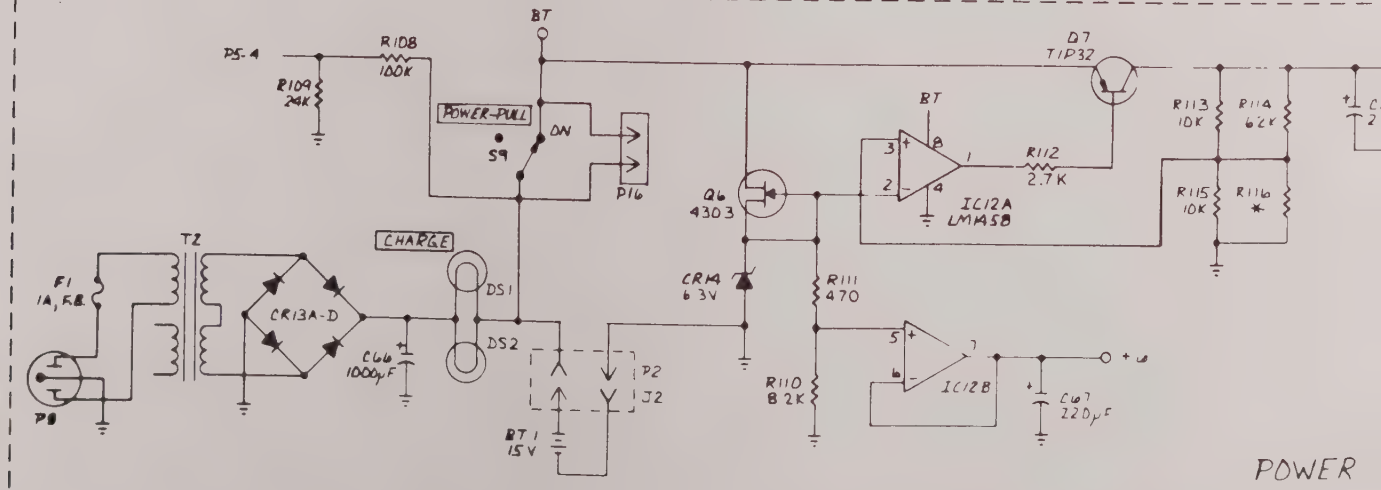
REVISIONS			WAVETEK
	ECN'S	BY	
A			C414-30-0026
B			
C	D1051		DRAWN BY / DATE / NUMBER
D	D1053		06-25-84
E			APP'D / 2 OF 2



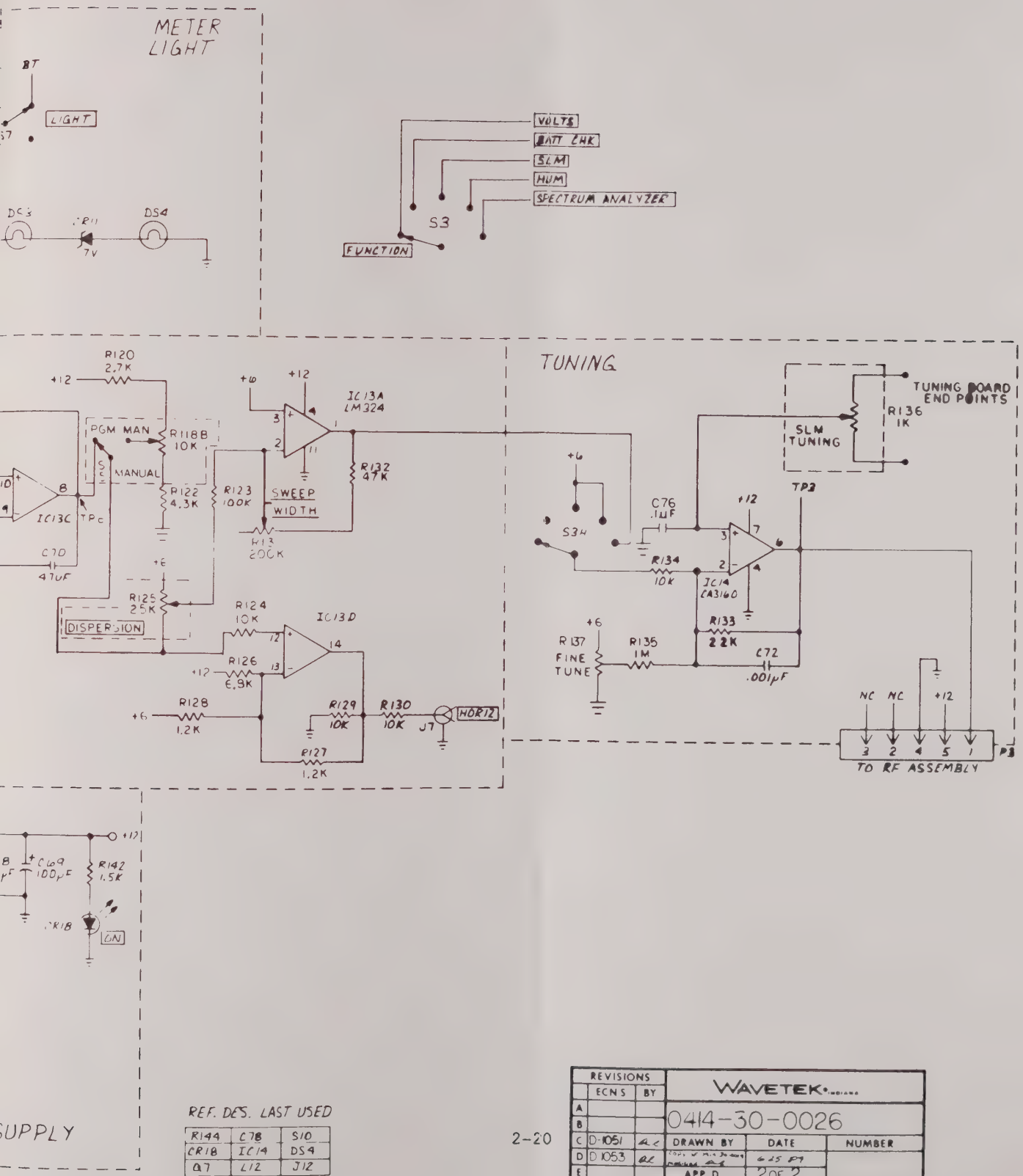




SPECTRUM ANALYZER



SAM I
MAIN BOARD



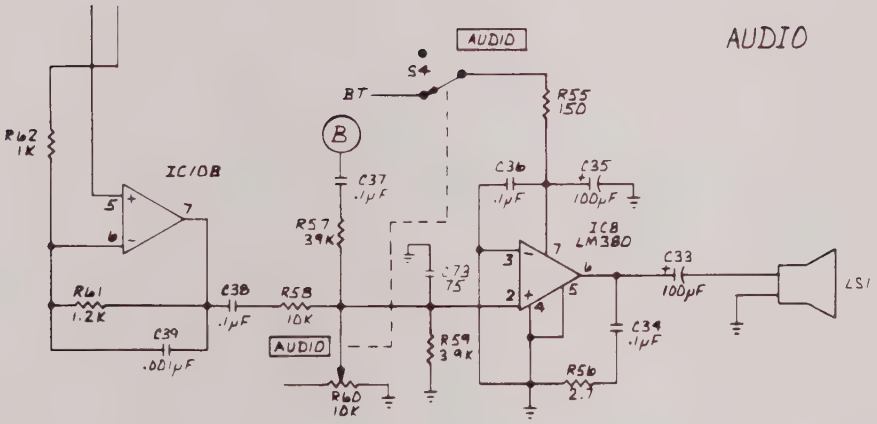
REF. DES. LAST USED

R144	C78	S10
CR18	IC14	DS4
Q7	L12	J12

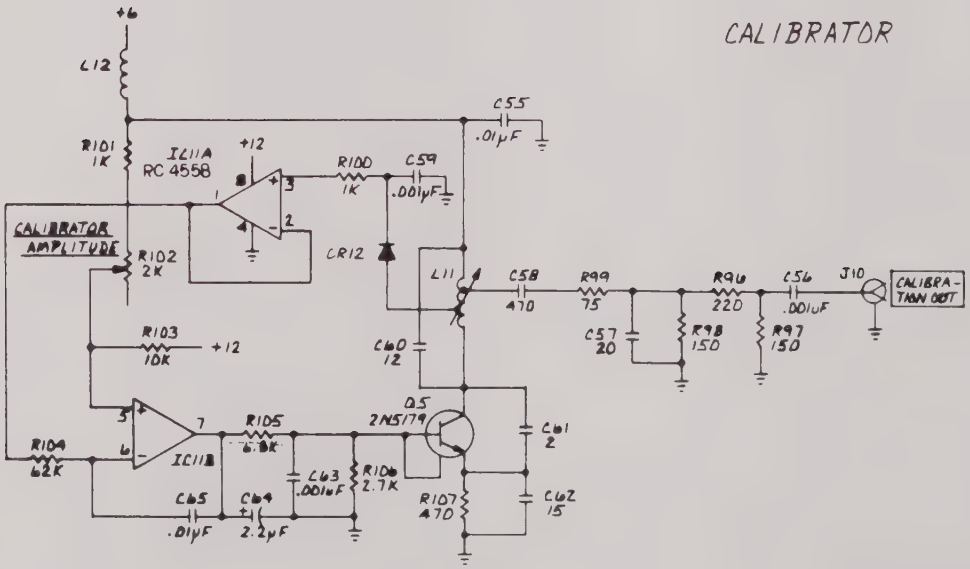
REVISIONS			WAVETEK
	ECNS	BY	
A			0414-30-0026
B			
C	D-1051	AC	DRAWN BY / DATE / NUMBER
D	D 1053	QL	6 25 89
E			APP D / 2 OF 2

AUDIO

The demodulated signal at the output of IC5 is coupled by C37 to volume control R60. The discriminator output is amplified by IC10B and coupled to the wiper of R60. This allows for a clear reception of the FM signal. The wiper of R60 is connected to pin 2 of IC8. The IC8 has an internal gain of approximately 200. This signal is then coupled through C33 to the speaker. The purpose of C34 and R56 is to prevent high frequency (100kHz) oscillations.

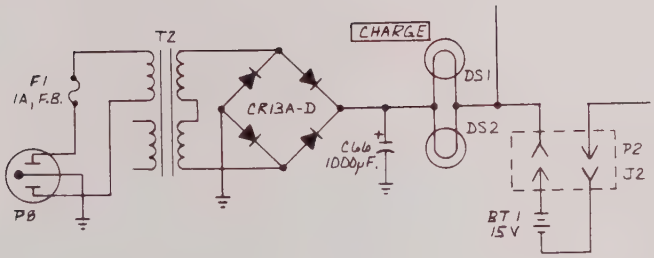


Q5 is configured as a common base oscillator. The feedback is accomplished through C61. C60 and L11 form the frequency determining tank circuit. CR12 and C59 detect a sample of the output. This detected voltage is then buffered by IC11A and applied to a comparator IC11B. R101, R102, and R103 provide a reference voltage that is also applied to a comparator IC11B. If the output level of the oscillator decreases, the detected voltage decreases causing the voltage on the inverting port of the comparator to decrease. This decrease in voltage causes the output of the comparator to increase. Since this voltage supplies the base bias, the transistor is driven harder, thus causing the amplitude of the oscillator to increase. This action provides a very stable closed loop leveling of the oscillator amplitude. C58 couples the output of the oscillator to a 75 ohm attenuator pad. The output at +20 dBmV is connected to the front panel F connector.



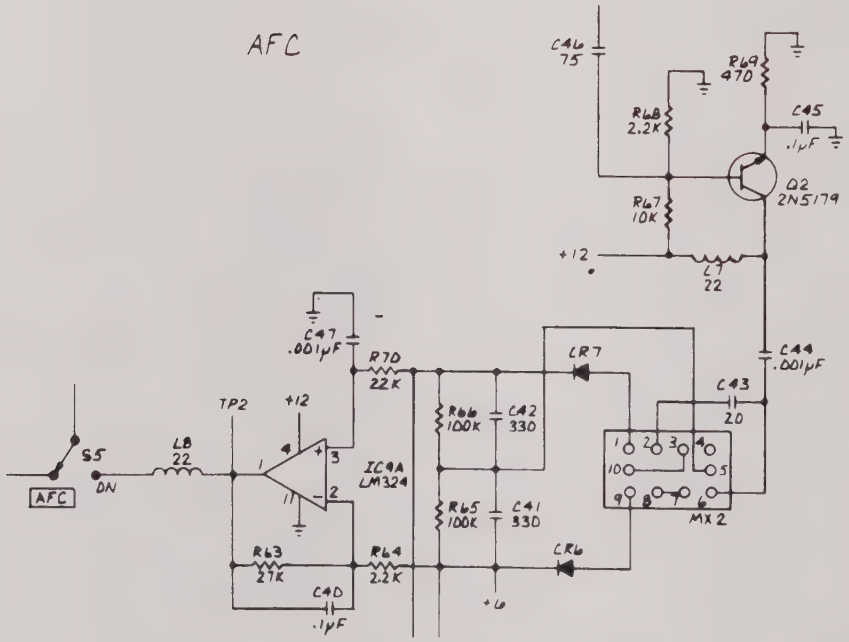
CHARGE CIRCUIT

The 110 VAC is applied through the front panel receptacle to transformer T2. T2 steps the voltage down to approximately 16 VAC. This voltage is then rectified by a full-wave bridge rectifier, CR-13. This voltage is filtered by C66 and applied to the battery by way of DS1 and DS2, which acts as a current limiter.



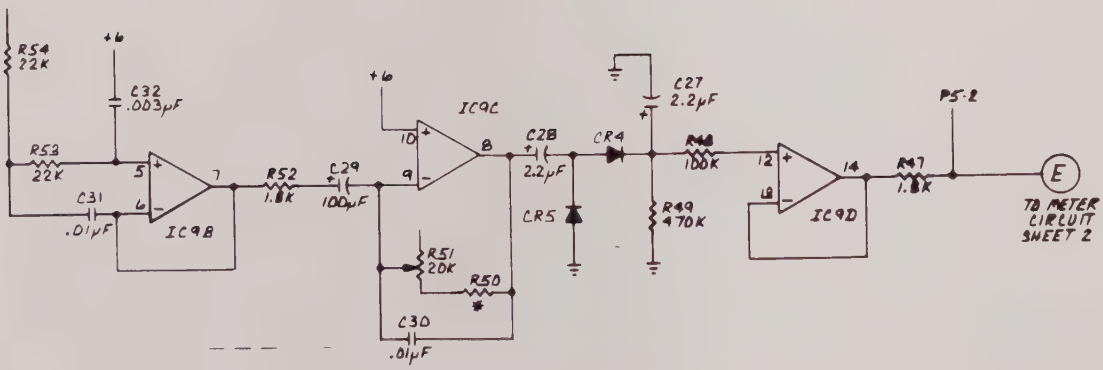
DISCRIMINATOR

The second output-pin of IC3 is a buffered output of the 10.7 MHz signal which is further amplified by Q2, which functions as a limiter. This amplified signal is then applied to the discriminator transformer (MX-2). The discriminator output as seen on pin 3 of IC9A will increase or decrease in voltage as the IF signal increases or decreases in frequency. This voltage is amplified by IC9A and the output pin 1, is applied to a varactor diode (BB105) in the 3rd L.O. (35.05 MHz). When the AFC switch is on, this voltage at the varactor will change. This changing voltage results in the 3rd L.O. increasing or decreasing in frequency, thus causing the mixed output to result in 10.7 MHz.



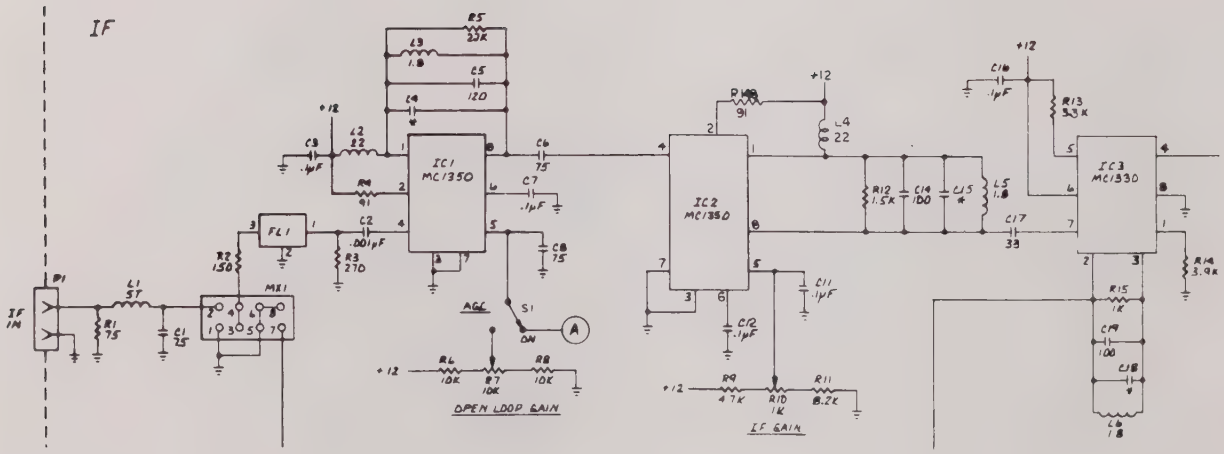
HUM

The hum circuit is designed to measure low frequency modulation. The peak detector circuit is disabled in the hum mode. It is disabled because you are not interested in reading a peak signal, but the amount of low frequency modulation onto the carrier. The output of the video amplifier (IC4 pin 6) is applied to an active filter consisting of IC9B. This active filter is designed to pass frequencies up to 500 Hz. This 500 Hz is to allow for an accurate measurement, if the hum is a square wave. Square waves contain frequencies much higher than the fundamentals. The 60 Hz signal if present is AC coupled to IC9C, which amplifies the signal. This signal from IC9C provides a 6V reference. The AC signal is applied to a voltage doubler (P-P detector), consisting of CR4, CR5, C27 and C28. The DC voltage is buffered by IC9D and applied to the meter movement through R47.



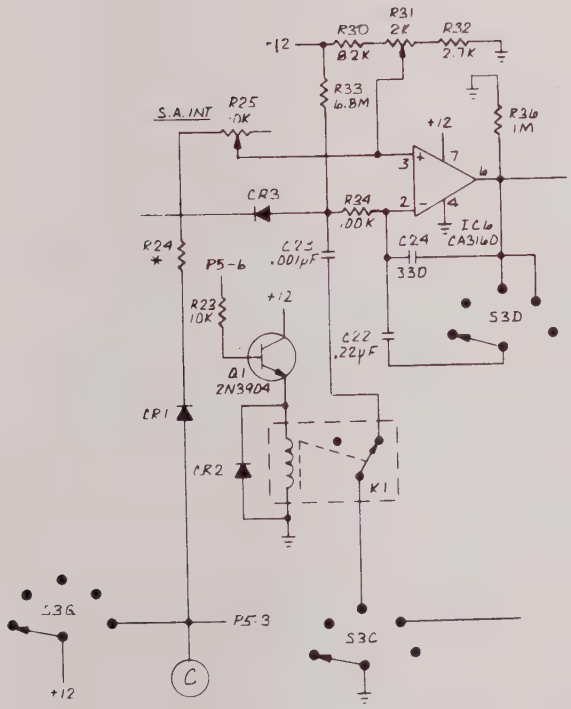
I.F.

The IF signal is applied at P1. The R1 is a 75 ohm termination. L1 and C1 provide for a low pass filter. The signal is then mixed with a 35.05 MHz signal in MX-1. The resultant output of 10.7 MHz is applied to a ceramic filter FL-1, which limits the bandwidth to approximately 280 kHz. The signal is then amplified by IC1 (1350), which is capable of 50 dB of gain. The IC1 has an AGC range of 60 dB. This circuit has to be tuned to 10.7 MHz in order to achieve the high gain. This tuning is accomplished by C4, C5 and L3. The R5 provides decueing to allow for correct bandwidth. This amplified signal is capacitively coupled to IC2, which provides an additional 20 dB of gain. This gain can be varied by R10. This may need to be changed to provide optimum meter tracking. This circuit also needs to be tuned to 10.7 MHz by C14, C15 an L5. The R12 provide decueing to allow for correct bandwidth. This amplified signal is applied to IC3, which provides additional gain and incorporates the video detector. This circuit is tuned to 10.7 MHz by C18, C19 and L6. The R15 provides decueing to allow for correct bandwidth. At TP-1 there isn't any RF present, however there is some modulation.



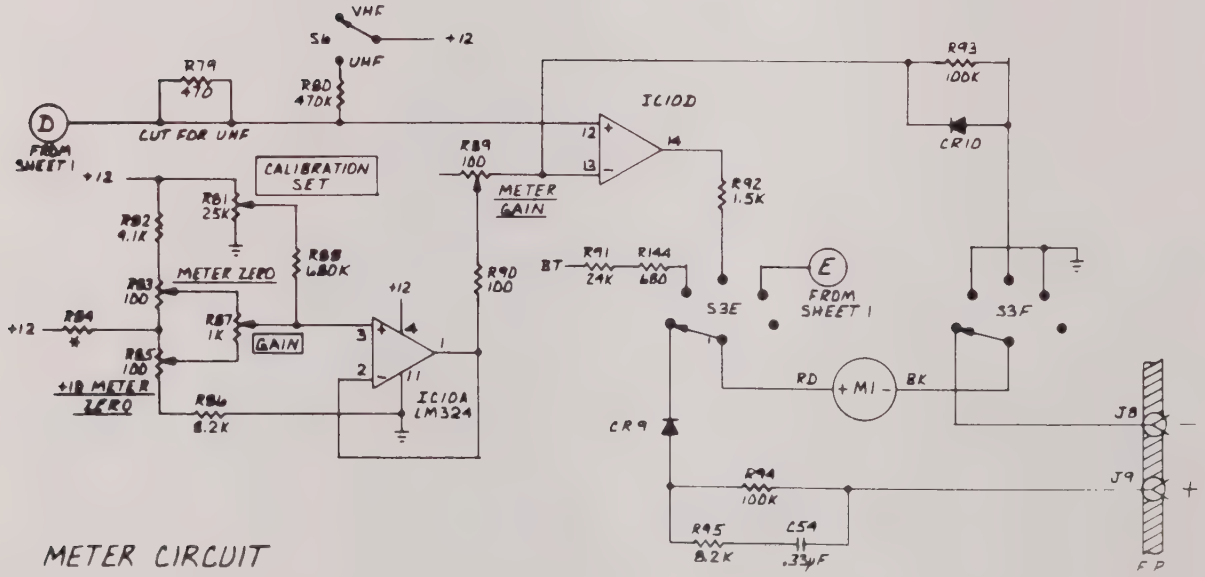
INTEGRATOR

The integrator is a comparator used to supply the AGC voltage. A reference voltage is set up on pin 3 of IC6, which is controlled by R31. When a strong IF signal is applied to the IF input, the voltage on pin 2 decreases. As this voltage decreases, the voltage on pin 6 increases. This signal is buffered by IC10C. The output at pin 8 is applied to pin 5 of IC1. This feedback will decrease the gain of the 1350. This AGC loop maintains a constant signal level through the IF. The purpose of C22 and C24 is to slow the comparator to prevent oscillations. When in the spectrum analyzer mode, 12V is applied to CR1 through R24 and R25. This changes the integrator reference voltage a very small amount. This integrator voltage changes the gain of the IF (since the integrator supplies the AGC voltage). The R25 adjusts this level for the best spectrum analyzer display.



METER CIRCUIT

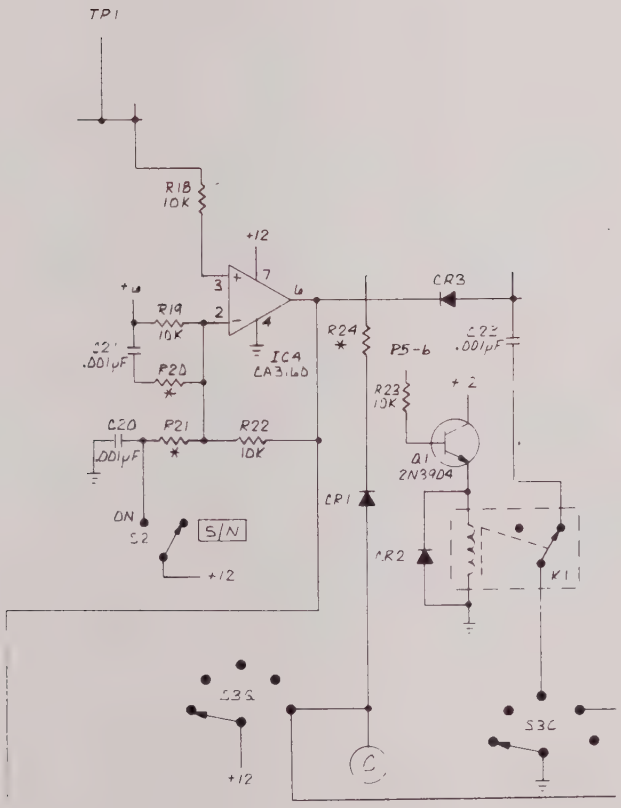
The meter circuit is driven by the AGC voltage rather than the detected IF. The purpose of IC10A is to provide a reference voltage to be compared with the AGC voltage. The main reference is set up by R82, R83, R84, and R85. The R81 will provide a small amount of deviation to this main reference voltage. The R87 is used to increase this reference voltage a very small amount, to boost the meter reading by 10 dB for reading the low signal levels. IC10A is merely a buffer to provide isolation between the voltage divider and the meter amplifier. IC10D is a voltage to current converter. As the voltage increases on pin 10 above the voltage on pin 13, the voltage on pin 14 also increases. This voltage at pin 14 will cause current to flow through the meter and through CR10. The CR10 is forward biased and therefore allows the current to flow back through R92 to IC10D. Since the amount of gain is determined by the feedback resistance divided by the input resistance, the gain can be varied by the input resistance of R89. The R89 is used to calibrate the high end of the meter.



METER CIRCUIT

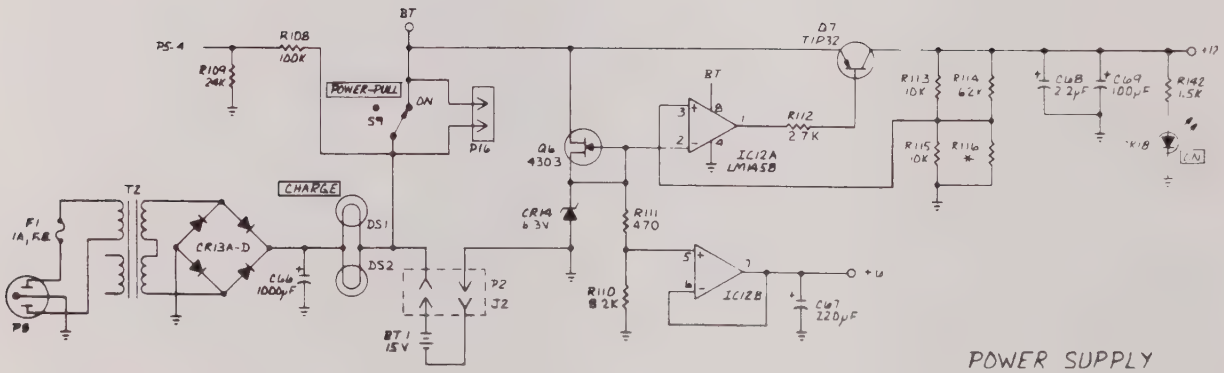
PEAK DETECTOR

The detected output from the IF is amplified by IC4 and is fed to a peak detector of CR3 and C23. The purpose of this detector circuit is to charge up C23 to the peak value of the modulation. All signal level meters measure peak value not average or RMS values. No detector is perfect and since C23 will discharge a certain amount, this voltage will still not be an absolute peak value. The purpose of C21 and R20 is to boost the gain of IC4 a small amount when video modulation is present. The C23 provides a ground path for the peak detector circuit.

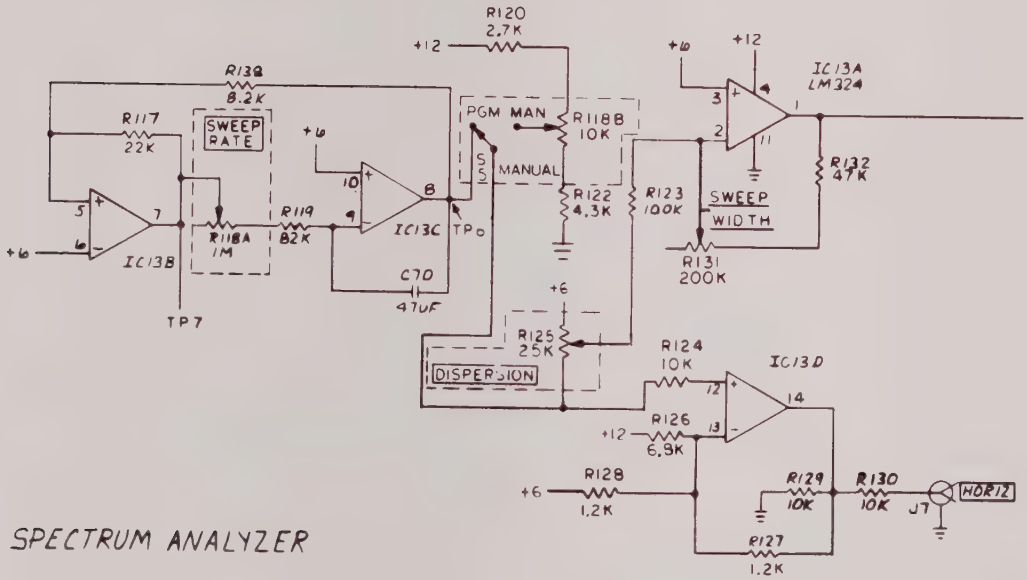


POWER SUPPLY

Q6 supplies a constant current source for zener diode CR14. The CR14 provides a 6.2 V reference, which goes to a voltage divider of R110 and R111. This 6.2V reference is buffered by IC12B. The 6.2 V reference is applied to the inverting port of comparator IC12A. When power is first applied, the output on pin 1 of IC12A will be high, which causes Q7 to conduct very slightly. This allows only a small voltage to be seen on the output of the supply. The supply voltage is applied to a voltage divider of R113, R114, R115 and R116. The voltage divider cuts voltage approximately in half. This voltage is applied to the non-inverting port of IC12A. Since this voltage is lower than the voltage on pin 2, the output on pin 1 will decrease, Q7 conducts harder, which supplies a higher supply voltage. The supply voltage is regulated by comparing the values of the two input voltages of IC12A. R116 is chosen to result in a 12V reference.



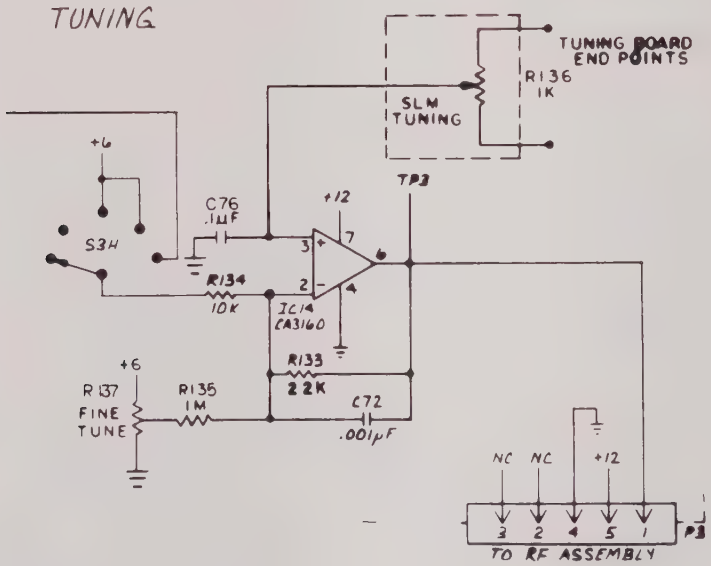
IC13B and IC13C form a ramp oscillator, whose frequency is varied by R118. This ramp voltage is applied to IC13D, where it is amplified to provide the horizontal drive required for the oscilloscope. The ramp output from IC13C is also applied to a separate amplifier of IC13A. The IC13A's output (an inverted ramp), is applied to the tuning circuit. The IC13A causes the 1st L.O. frequency to increase and decrease corresponding with the horizontal drive to the oscilloscope. The dispersion potentiometer (R125) is used to increase or decrease the amplitude of the ramp signal applied to the tuning section. This dispersion potentiometer allows for a small or large span of frequencies. The auto/manual switch (S5) allows the tuning voltage to be varied manually, by adjusting the manual sweep potentiometer (R118).



SPECTRUM ANALYZER

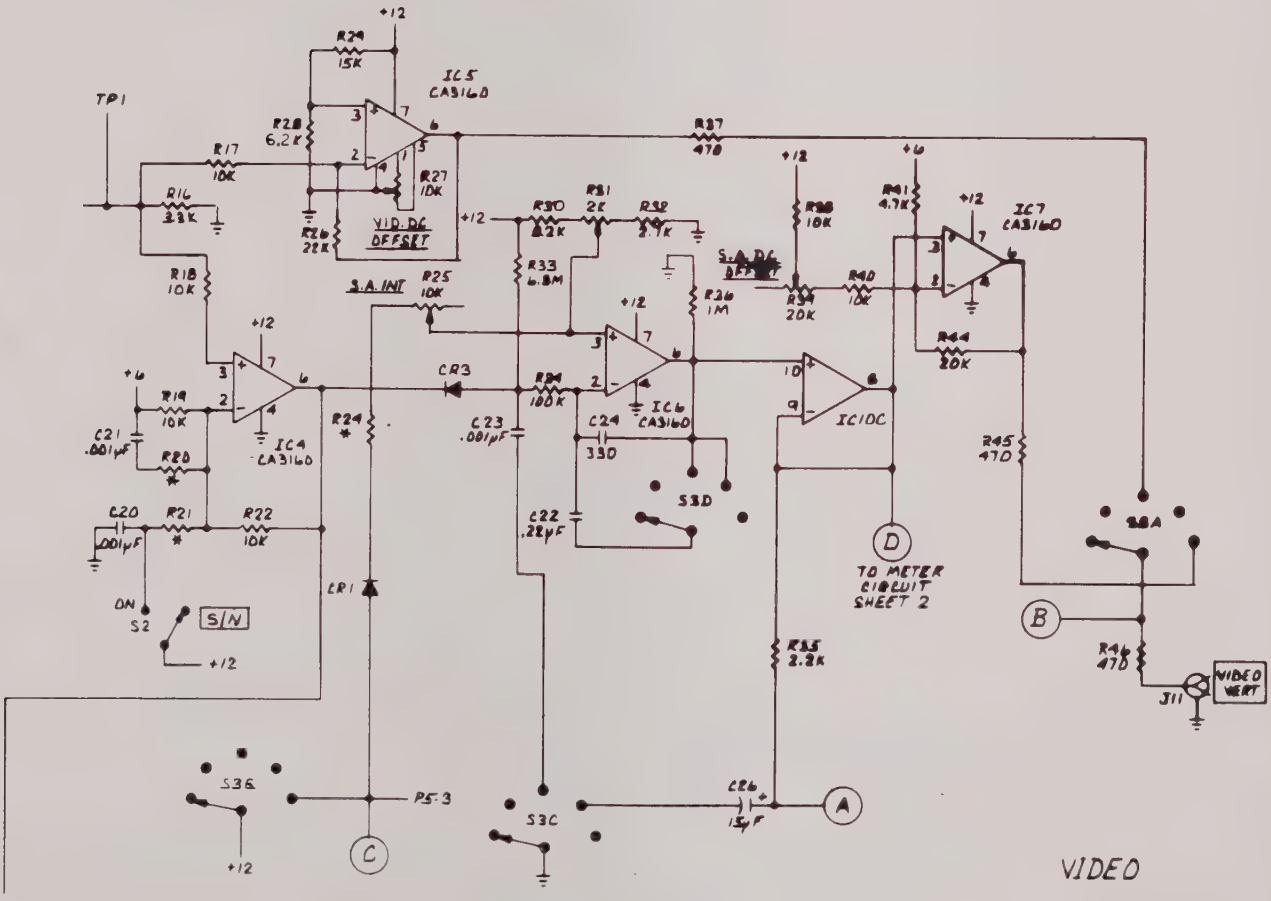
TUNING CIRCUIT

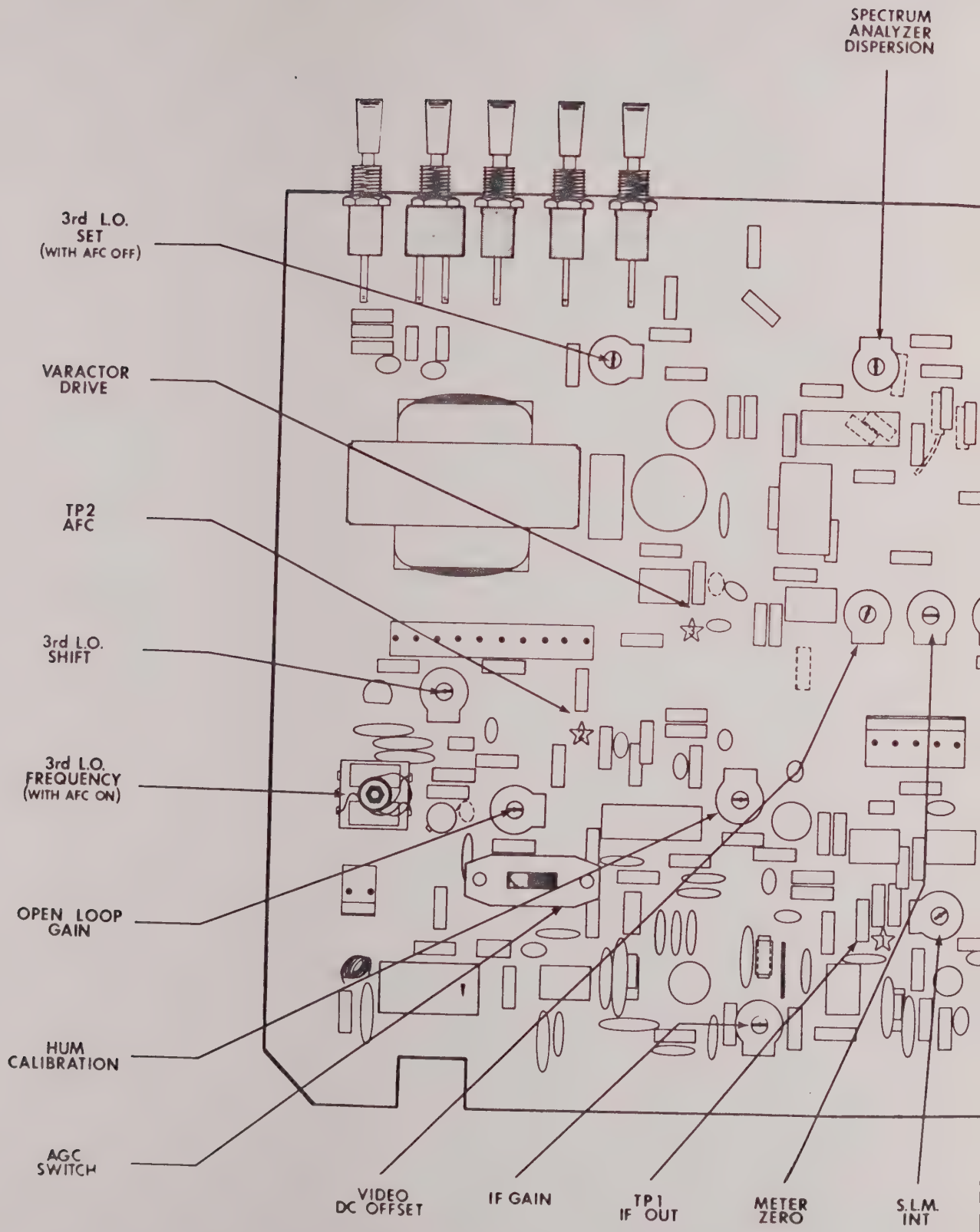
This circuit consists of a series of voltage divider networks, which can be switched between bands by S201. The two voltages, which are selected by S201 and applied to pin 5 of IC201A and pin 3 of IC201B, are buffered through the 1458 to provide isolation. These two outputs are then applied to R136 on the front panel. The wiper of R136 (course tuning potentiometer) will have a voltage corresponding to the band selected on the front panel. This voltage is amplified by IC14 and its output (pin 6) is then applied to RF assembly. R137 and the fine tuning potentiometer allow for a very small change in the output voltage.

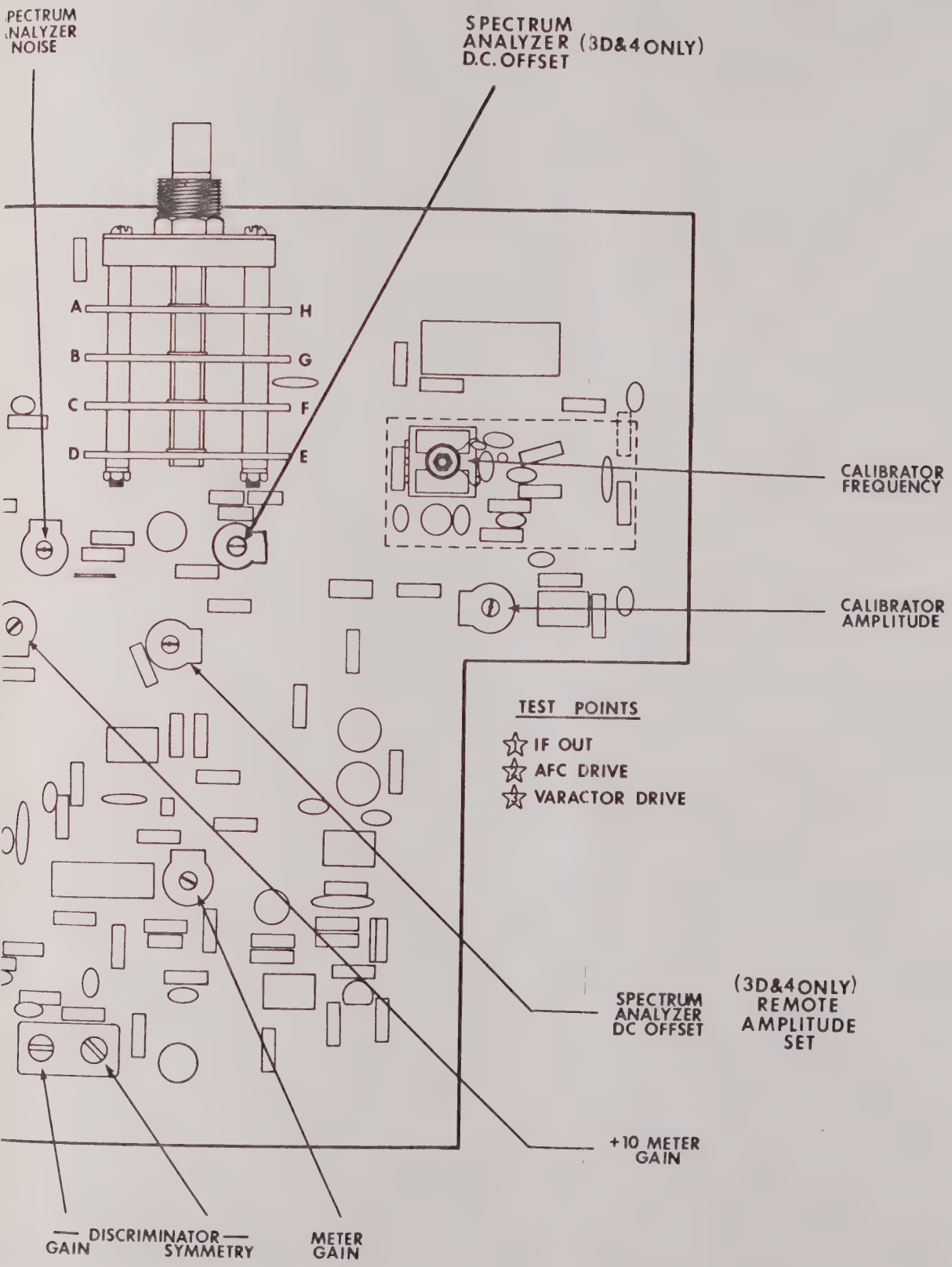


VERTICAL/VIDEO AMPS

The purpose is to provide a video output that can be monitored with an oscilloscope. The detected signal from IC3 pin 4 is amplified by IC5 and fed through S3A function switch to the front panel F connector. The combination of R28 and R29 and the DC offset potentiometer (R27) is to provide an offset voltage of approximately .2V. The IC7 provides the vertical output for the oscilloscope in the spectrum analyzer mode. The IC7 amplifies the AGC voltage from IC10C, pin 8. The R38, R39, R40 and R41 provide an offset voltage to place the baseline of the noise level at OV.




SPECTRUM ANALYZER DISPERSION
3rd L.O. SET (WITH AFC OFF)
VARACTOR DRIVE
TP2 AFC
3rd L.O. SHIFT
3rd L.O. FREQUENCY (WITH AFC ON)
OPEN LOOP GAIN
HUM CALIBRATION
AGC SWITCH
VIDEO DC OFFSET
IF GAIN
TP1 IF OUT
METER ZERO
S.L.M. INT


PECTRUM
NALYZER
NOISE
SPECTRUM
ANALYZER (3D&4 ONLY)
D.C. OFFSET
A
B
C
D
H
G
F
E
CALIBRATOR
FREQUENCY
CALIBRATOR
AMPLITUDE
TEST POINTS
IF OUT
AFC DRIVE
VARACTOR DRIVE
SPECTRUM
ANALYZER
DC OFFSET
(3D&4 ONLY)
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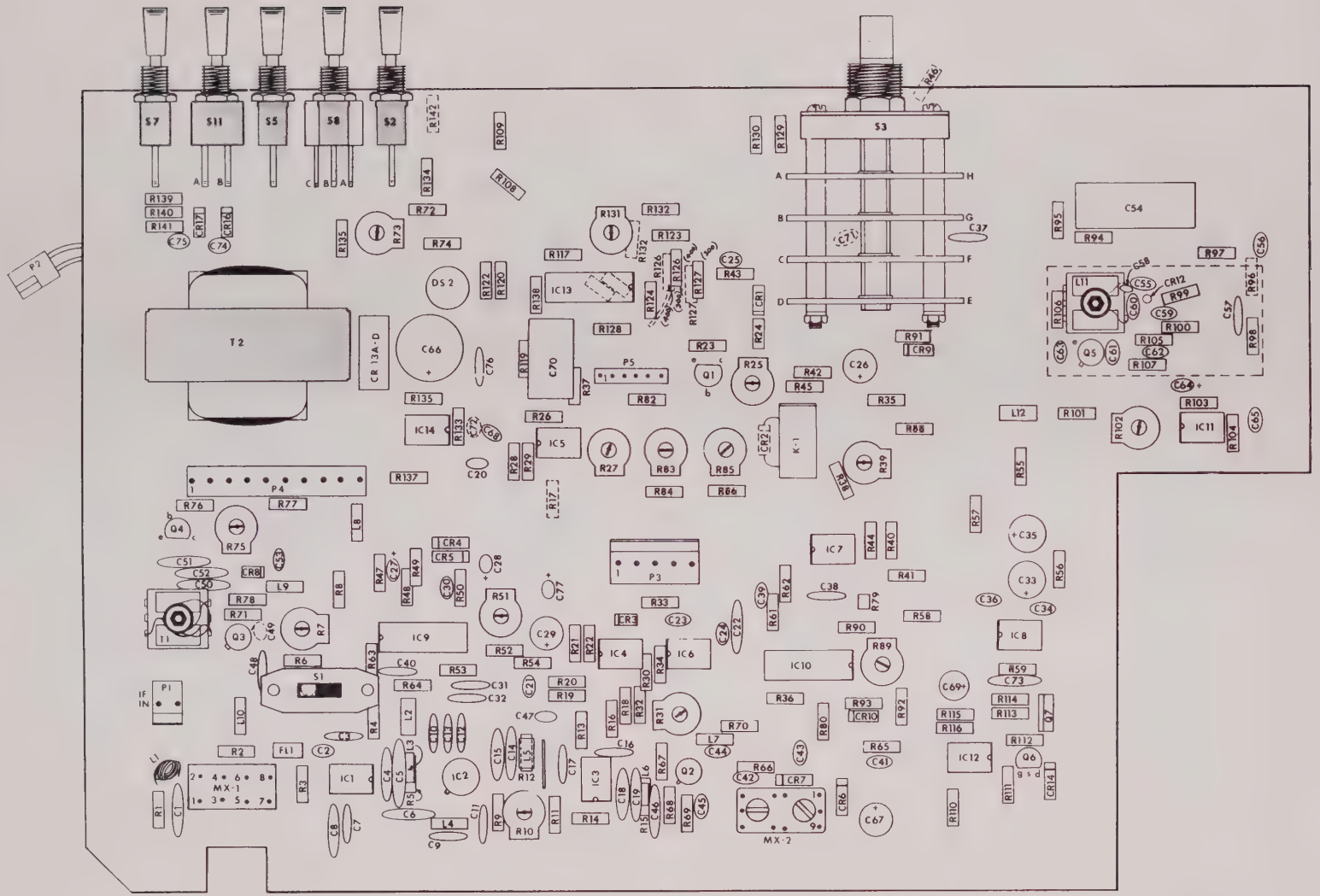
GAIN
SYMMETRY
METER
GAIN



PC 1655Y
SAM
MAIN BD

SAM I MAINBOARD PRELIMINARY CALIBRATION

I. Physical Inspection
   1) Examine unit for defects.

II. Voltmeter
   1) Place function switch to "volts" position.
   2) Connect a voltage source to the front panel voltmeter jacks and check meter reading. Accuracy must be ±5%.

III. Charge Circuit
   1) Plug A.C. charge cord into 110Vac and connect to the unit. Connect a dummy battery of 110Ω in place of a battery or power source.
   2) Turn the unit on and.the "ON" charge lamp on the main PCB should light. Turn unit off and the charge lamp should dim.

IV. Power Supply
   1) Connect battery cable to external power supply at 14V.
   2) Turn on power switch and check 6V supply for 5.85V to 6.1V.
   3) Connect voltmeter to 12V supply and select resistor value of R116 to read 12.0V to 12.1V.
   4) Place function switch in the "batt. ck" position and lower the voltage source to 12.5V The meter should read "recharge".
   5) Vary the voltage source from 12.5V to 16.0V. The supply should not change more than ±.005V.

V. Meter and Display Lights
   1) Turn on light switch, the two lamps in the meter should light.

VI. Varactor Drive
   1) Function switch needs to be in SLM mode.
   2) Connect a voltmeter to test point 3 (pin 6 of IC14). Turning the tuning potentiometer from one extreme to the other should produce a varactor drive voltage of 0 to 12V.(0=.05V maximum,12=11.8V minimum).

VII. Spectrum Analyzer
(Analyzer Units Only)
   1) Connect scope probe from the demod input of an 1801 sweeper to horizontal output connector of the SAM.
   2) Set vertical sensitivity to 2V per division, and horizontal time base to 5ms.
   3) Place the function switch in Spectrum Analyzer mode.
   4) Place sweep rate/manual switch in the manual position. By varying manual control potentiometer, you should see a voltage go from 0 to 9V.
   5) Place sweep rate/manual switch in sweep rate position. By varying sweep rate control potentiometer, you should see a sawtooth waveform go from 0 to 9V with waveform varying from flat to full angle.

VIII. 3rd L.O.

1) Must be in open loop.
2) Place function switch in SLM position. Turn AFC on.
3) Connect a pick off loop to a frequency counter capable of reading 35.05 MHz.
4) Hold up the pick off loop near the 3rd L.O. tuning coil (T1), as far away as possible to maintain as accurate reading.
5) Using a tuning stick, adjust slug in coil (T1) for a frequency of 35.05 MHz. Turn off AFC and adjust R73 for 35.05 MHz.
6) Repeat step 5 above until AFC off and AFC on, both result in a frequency of 35.05 MHz ±.03 MHz.

IX. Sweep IF

1) Must be in open loop. (Open loop is achieved by placing slide switch S1 in its right side position.)
2) Using an IF cable, inject a signal at the IF input on the mainboard.
3) Adjust sweep to center frequency of 45.75 MHz, sweep width 1MHz at +20 dBmV and sweep rate = 100 msec.
4) Connect a scope probe to the video vertical connector on the Sam.
5) Set scope vertical position to .2 V per division.
6) Set the scopes horizontal input to .5 V per division and connect the scope to the horizontal output of the sweeper.

X. Video Offset

1) Must be in open loop.
2) Adjust R27 for a dc level of .1 V above ground.
3) Adjust R7 for an open loop gain for about a .1 V signal.

XI. AFC

1) Must be in open loop.
2) Connect scope probe to test point 2.
3) Set scope vertical to .1 V per division and adjust the pink slug of the discriminator for maximum amplitude, and the blue slug for symetrical waveform. The signal should be at least 4 V peak to peak.

XII. Tune IF

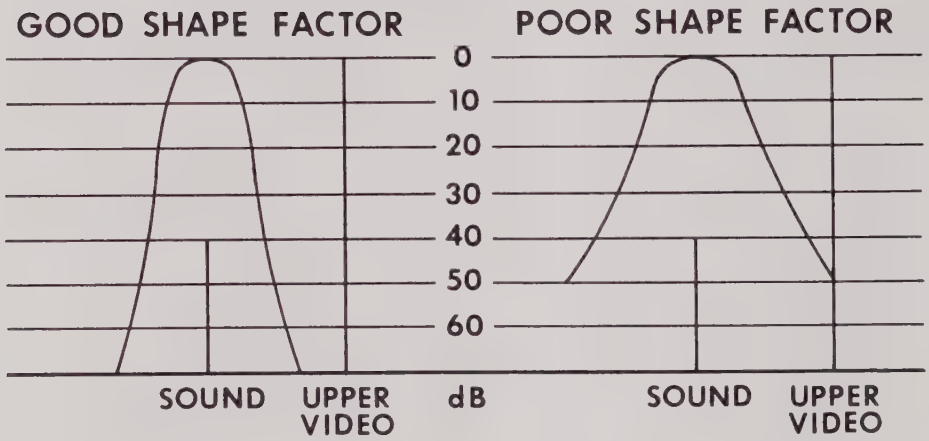
1) Must be in open loop.
2) Re-connect the scope probe to the video vertical connector on the Sam.
3) Scope vertical sensitivity should be .2 V per division.
4) Using test probe, inject a signal at pin 1 of IC2 (1550).
5) Adjust sweep to 10.7 MHz center frequency, sweep width of about 1 MHz and amplitude to + 10 dBmV.
6) Select capacitance values across the 2nd and 3rd tank circuits in the IF, C15 and C18 until the response is centered a 10.7 MHz. Remove test probe.

XIII. Shaping Response

1) Must be in open loop
2) Using an IF cable, inject a signal at the IF input of the Sam.
3) Frequency should be at 45.75 MHz, sweep width = 1 MHz, at +20 dBmV.

4) If necessary, select a capacitor value C4 across the first IF tank circuit to achieve a flat or haystacked response, rather than a tilted, notched or pointed response. Solder capacitor in place.

REFER TO PICTURES BELOW FOR TYPICAL GOOD IF RESPONSE AND BAD IF RESPONSE



XIV. Open Loop Gain

1) Set scope vertical to 1 V per division and adjust the pink slug of the discriminator for maximizing amplitude, and the blue slug for a symetrical waveform. The signal should be at least 4V peak to peak.

XV. AFC

1) Must be in open loop.
2) Connect scope probe to test point 2.
3) Set scope vertical to 1 V per division and adjust the pink slug of the discriminator for maximizing amplitude, and the blue slug for symetrical waveform. The signal should be at least 4 V peak to peak.

XVI. Integrator

1) Must be in closed loop. (Side switch S1 is in its left side position.)
2) Connect scope probe to test point 1, pin 4 of IC3 (1330).
3) Set scope vertical to .5 V per division, and adjust vertical position until an inverted response appears.

4) Close loop switch and place sweeper in manual sweep mode. Sweep through from no signal to a maximum signal. The maximum signal condition should lower the response by .4 V.
5) Adjust R31 for a .4 V difference.

XVII. Meter Tracking

1) Must be in closed loop.
2) Place function switch to the SLM mode, set potentiometers R81 (cal. set), R84 (10 dB gain), R87 (+10), R83 (-10) and IF gain to center of their positions.
3) Front panel +10 dB gain potentiometer should be in cal position.
4) Using an IF cable, inject a signal from an MC-50 or your meter calibrator,at 45.75 MHz and at +20 dBmV. Watch the meter, adjust frequency of MC-50 for maximum amplitude.
5) If necessary, select a resistor value R84 to achieve a mid scale reading.
6) Re-adjust frequency of MC-50 for a maximum meter reading and repeat step 5 above if necessary.
7) Reduce MC-50 amplitude by 10 dB and adjust R83 for a left scale reading. return amplitude to original +20 dB.
8) Increase amplitude by 10 dB and adjust R85 for a right scale reading. Return amplitude to original +20 dB.
9) Repeat setup 7 above.
10) Reduce amplitude by 10 dB and turn front panel +10 dB gain potentiometer fully clockwise and adjust R89 for a mid scale reading. Return front panel +10 dB gain potentiometer to "cal" position. Reset R83 to read left scale.
11) Repeat steps 7 and 10 above.

XVIII. Peak Detector

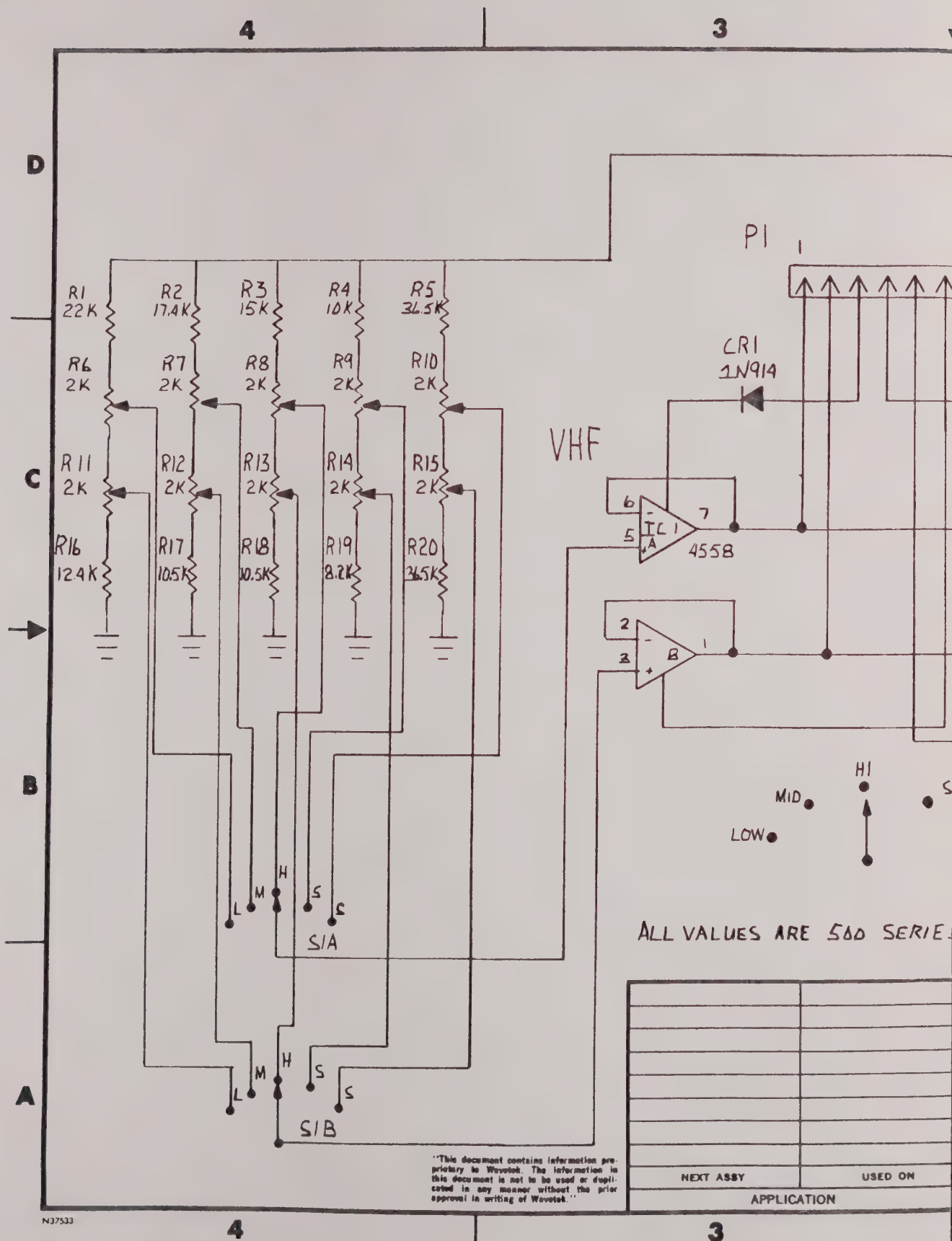
1) Connect an MC-50 to the FR input of the Sam and peak on a signal. Press the modulation switch of the MC-50, the needle of the meter should drop. Select a resistor and complete the circuit at position R20. Change the value of this resistor (27K ohm ± 10K ohm) until a needle drop of no more than .2 dB is achievced.

XIX. Hum

1) Use 27K ohm resistor to complete circuit position R50, check circuit.
2) Adjust R51 for mid scale, then switch a calibrated hum source from 2% to 4% hum modulation.
3) Adjust hum R51 for 2% and 4% meter scale. If unable to center, raise or lower resistor.

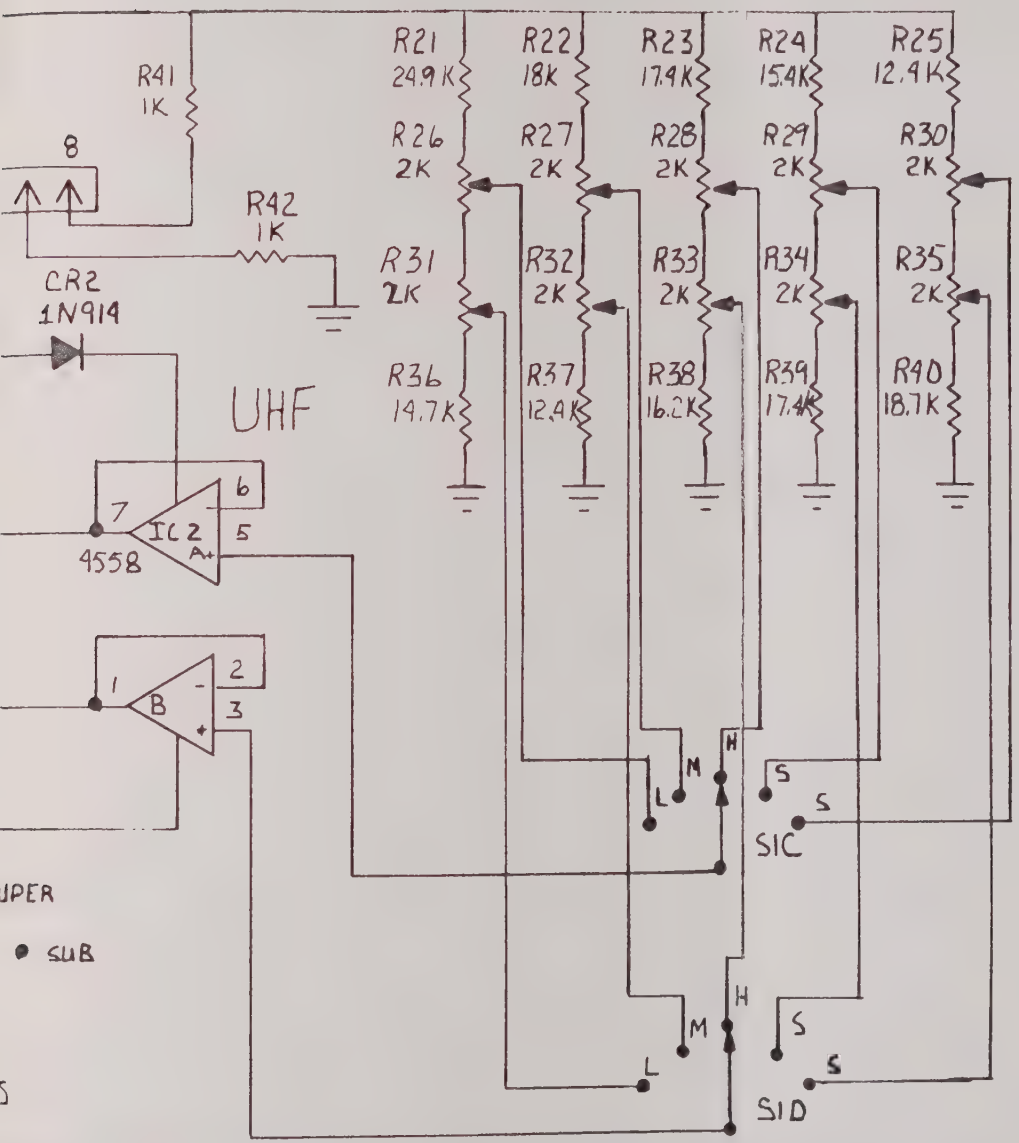
XX. Calibrator

1) Connect the calibrator output to a frequency counter capable of measuring 150 MHz.
2) Adjust the oscillator tuning slug, L11 for a frequency of 150 MHz and verify that the calibrator amplitude R102 does not alter the frequency more than 2 MHz.
3) Connect the calibrator output to a Sam and adjust the calibrator amplitude R102 to achieve +20 dBmV. Verify that the potentiometer still has ±2 dB of range, minimum.
4) Solder calibrator shielding can in place reset the frequency to 150 MHz ±.1 MHz.


4
3
D
C
B
A
R1 22K
R2 17.4K
R3 15K
R4 10K
R5 36.5K
R6 2K
R7 2K
R8 2K
R9 2K
R10 2K
R11 2K
R12 2K
R13 2K
R14 2K
R15 2K
R16 12.4K
R17 10.5K
R18 10.5K
R19 8.2K
R20 36.5K
P1
1
CR1 1N914
VHF
IC 1
4558
6
5
7
2
3
1
A
B
HI
MID
LOW
L
M
H
S
S
S1A
S1B
ALL VALUES ARE 500 SERIE
"This document contains information proprietary to Wavetek. The information in this document is not to be used or duplicated in any manner without the prior approval in writing of Wavetek."
NEXT ASSY
USED ON
APPLICATION
N37533

PICTURE

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± ± .XXX ±	CONTRACT NO.	WAVETEK INDIANA, INC.	
MATERIAL	APPROVALS / DRAWN TJM / CHECKED	DATE	SAM I UHF TUNING BOARD
FINISH			SIZE B · CODE IDENT NO. 34280 · DRAWING NO.
DO NOT SCALE DRAWING			SCALE · SHEET / OF /

SAM I UNIT CALIBRATION PROCEDURE

I Power Supplies
1) Check +6 VDC and +12 VDC power supplies. Should be ± .1 VDC.
a. Changing the value of R116 will adjust the + VDC supply.

II 3rd L.O.
1) Must be in manual mode with no signal applied.
2) Connect a pick off loop to a frequency counter.
3) Sample the frequency of T1 and adjust if needed to have a frequency of 35.05 MHz with AFC on.
4) With AFC off adjust R73 for a frequency of 35.05 MHz.

III 2nd L.O
1) All new Sam I meters have a tuneable 2nd L.O. Some of the older units have a crystal controlled 2nd L.O.
2) For a 300 MHz unit the 2nd L.O. frequency should be 354.25 MHz.
3) For a 400 MHz or 450 MHz the 2nd L.O. frequency should be 414.25 MHz.
4) Connect a cable from a frequency counter to the "F" connector on the bottom of the R.F. assembly. This is located near the right hand corner of the R.F.

IV. R.F. Gain, Flatness, and Sweep Width
1) Connect an I.F. cable from an 1801 sweep generator, R.F. out port, to the I.F. in on the mainboard of the Sam.
a. The generator should be set for an output of +20 dB at 45.75 MHz
b. Connect a cable from the "demod in" to "video vert." on the front panel.
c. Place the unit in open loop via S1 on the mainboard.
d. Set the scope for an X-Y display with the horizontal out of the generator to the horizontal amp of the scope.
e. Connect the vertical out to the generator to the vertical amp of the scope.
f. Set the scope to .2 V per division, also DC coupled.
g. Set the generator to 100 msec. sweep, with sweep time and sweep width for approximately 80 MHz.
h. Adjust R7 (open loop gain) for a signal at approximately .1 V.
2) Disconnect the I.F. cable from the sweep generator and replace it with the I.F. cable form the R.F. assembly.
a. Place the tuning board jack in the wide sweep position. This is one of the two jacks that is located on the tuning board that is closest to the wrap-around of the unit.
b. Connect the R.F. out cable from the generator into the R.F. in connector on the Sam.
c. Place the Sam attenuator to +20 dBmV-mid scale position.
d. Tune the generator to 150 MHz at +20 dBmV.
e. Tune the Sam to 150 MHz in manual mode. Observe the signal.

f. Peak all tuning caps and coils on the R.F. assembly starting with the one at the left front of the R.F.

g. Tune the coil on the bottom of the R.F. for a peak signal. You should be observing an R.F. signal approximately 36 to 40 dBmV.

h. Adjust R7 again after this for a 1 V signal. This finishes R.F. gain check.

3) To check the flatness use your reference voltage of 1 V.

a. Start by tuning the Sam and the sweep generator together down in frequency. Watch the scope and observe the amplitude, it should not change more than ±.7 dBmV from 10 MHz to the top range of your meter.

b. Observe the sweep to also insure that the weep width goes down to -10 to -12 MHz and up past the top range of your meter plus about 12 MHz.

4) UHF Calibration

a. Check UHF Flatness by first switching the Sam into UHF. Connect the 1801 sweeper to the RF input of the Sam. Set a 1 V refference at 471 MHz, sweep up to 890 MHz. The signal cannot very more than +3 dB.

b. The flattness characteristics of the UHF L.O. are very different than that of the VHF L.O. therefore in some cases a UHF meter compensation resistor is needed. With the unit in closed loop peak up on a 150 MHz +20 dB signal from a MC50.

c. Use the calibration set pot to set the meter right at 20 dB. Remove the MC50 and connect the 1801 sweeper to the Sam.

d. With the 1801 in manual sweep to 150 MHz and set the variable attenuator of the 1801 so that the Sam meter reads exactly 20 dB. Switch the Sam into UHF and using the 1801 find the highest meter reading and the lowest meter reading between 471 MHz and 890 MHz. If these readings are within ±1.5 dB of the 20 dB refference, no compensation resistor is needed. If however the lowest UHF reading is not within 1.5 dB of 20 dB select a resistor of 1 M and place it in position R80. Repeat the a bove steps, being sure to reset the 150 MHz 20 dB reference. If the lowest UHF reading is still not within 1.5 dB of 20 dB, reduce the value of resistor R80. Make sure you check the highest UHF reading to see that it is not more than 1.5 dB greater than 20 dB. If you are unable to get the UHF readings within ±1.5 dB of 20 dB, the UHF L.O. board requires work and must be sent to the factory for repair.

NOTE

IF YOU DO NOT HAVE A SAM I 450 MHZ UNIT WITH THE A-E BANDS WITH THE SUB BAND THE DIAGRAM BELOW WILL BE SUBJECT TO CHANGE. IF THERE ARE ANY QUESTIONS PLEASE CONTACT THE CATV PRODUCT SERVICE DEPARTMENT.

V. Dial Tracking

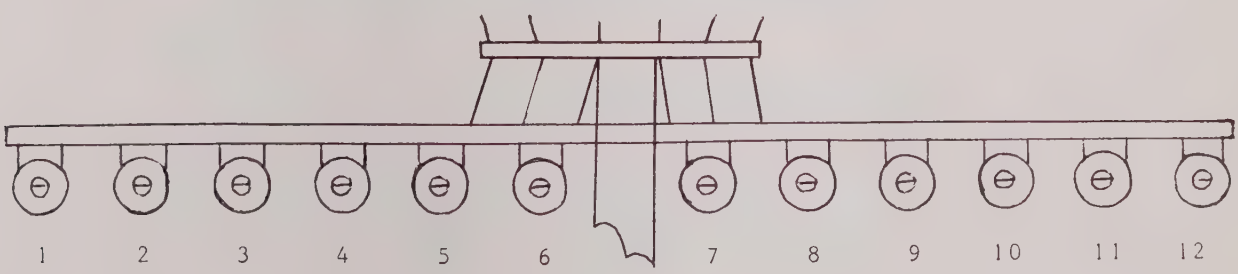
1) Leave unit in the same set up as listed in step IV.
2) With unit left in the open loop mode of operation, place the tuning board jack in the left socket on the tuning board, this will be away from the wrap-around.
3) Place the bandswitch to the Sub band position.
4) Adjust the generator for a 50 MHz sweep width and frequency from 10-50 MHz.
5) Center the fine tune potentiometer.
6) Turn the course tune potentiometer on the Sam to 10 MHz, and adjust the #6 potentiometer to be set at 10 MHz.
7) Then turn the course tune potentiometer on the Sam to 50 MHz, and adjust the #12 potentiometer to be set at 50 MHz.
8) Follow this same procedure for all of the bands. Set it first at the low frequency for each band and then the high frequency for each band. Refer to the diagram on the next page for the numbering of the potentiometers and the low and high frequency for each band
9) Use the frequencies in Fig. below for UHF dial tracking first set the end points of band A using an 1801 sweeper and scope. After the end points are set, check each UHF frequency. They must be within ±6 MHz. Repeat these steps for the remaining bands.

VHF FREQUENCIES

BAND	LOW FREQ.	POT. #	HIGH FREQ.	POT. #
A	50 MHz	1	132 MHz	7
B	132 MHz	2	210 MHz	8
C	210 MHz	3	288 MHz	9
D	288 MHz	4	372 MHz	10
E	372 MHz	5	450 MHz	11
Sub.	10 MHz	6	50 MHz	12

UHF FREQUENCIES

BAND	LOW FREQ.	MID FREQ.	HIGH FREQ.
A	471 MHz	513 MHz	555
B	555 MHz	597 MHz	639
C	639 MHz	681 MHz	723
D	723 MHz	765 MHz	807
E	807 MHz	849 MHz	891



VI AFC

1) Connect the Scope probe to IC9 pin 1, set the scope to 1 V per division.
2) Tune the Sam and 1801 sweeper to 150 MHz at +20 dBmV.
3) Tune MXI (discriminator coil) blue coil for a symmetrical signal, and adjust the pink coil for maximum amplitude-may need to adjust the blue coil again.

VII Integrator

1) Must be in closed loop. Connect scope probe to test point 1, pin 4 of IC3.
2) Set scope vertical to .5 V per division, and adjust vertical position until an inverted response appears.
3) Put in closed loop and place the sweeper in manual sweep mode. Sweep through from no signal to a maximum frequency signal. The maximum signal condition should lower the response by .4 V, adjust R31 for a .4 V difference.

VIII. Meter Tracking

1) Set the +10 dB gain potentiometer to Cal. position and the cal set potentiometer to midrange.
2) R84 will be approximately a 220K ohm resistor.
3) Set the Sam attenuator to the +30 dBmV mid scale, and adjust R83 for a +20 dBmV reading on the left side of the meter movement.
4) Set the Sam attenuator to the +20 dBmV mid scale, and adjust R89 for a +20 dBmV reading on the left side of the meter movement.
5) Turn +10 dBmV potentiometer on the front panel all the way clockwise and adjust the Sam attenuator to +30 dBmV mid scale reading. Adjust R85 for a +30 dBmV reading.
6) Set the Sam attenuator to +40 dBmV mid scale reading and adjust R10 if necessary to make minor adjustment to low end. Go to the +20 dBmV attenuator setting at mid scale and check high end reading.

IX. Peak Detector

1) R20 is selected to be approximately 22K to 39K ohm resistor.
2) Connect your MC-50 preferably (meter calibrator) out to the Sam R.F. in.
3) Tune your calibrator to 150 MHz at +20 dBmV.
4) Tune the Sam to 150 MHz and peak on the signal.
5) Turn on TV modulation, and the signal on the Sam should read +19.75 dBmV to +20 dBmV. If you do not have the reading in this window of range then change the value of R20.

X. Hum

1) R 50 is selected for hum to be 27K ± 10K ohm resistor.
2) Connect your hum source.
3) Tune the Sam to the frequency of the source.
4) Switch to hum. The needle will peg momentarily inhouse. The hum will read within ± .3 % of your hum source. The low level will read less than .5%, the next level will be 2% ±.25%,and the last level will be 4% ±.25%. Adjust R51 as needed to achieve these levels.

XI. Analyzer

1) CR1 and R24 are selected for the analyzer circuit CR1 is a IN914 diode, and R24 is typically between a 18K to 24K ohm resistor.
2) Adjust your scope for X-Y display, plug cable from the Sam horizontal to scope horizontal.
3) Connect the video vertical on the Sam to the vertical on the scope.
4) Set the scope to .5V per division.
5) Set the Sam function switch to analyzer and manual/sweep switch to sweep.
6) Set the sweep rate fully clockwise and dispersion fully clockwise on the Sam.
7) Adjust R25 for the noise level of .4 V to .6 V.
8) Adjust R39 DC level potentiometer for the lower peaks to be cut off.
9) Using your dispersion control should allow you to see 0 MHz to the top frequency your particular meter is specified for.
10) All spurs should be at least 20 dB down from your reference signal at +20 dB.

XII. S/N

1) Tune Sam to your calibrated frequency (ours is at 63 MHz) to achieve a peak reading. Select R21 typically an 80 K (± 20 K) ohm resistor for a S/N reading after depressing switch to be ± 1 dB from your standard.

XIII. Video

1) Connect the video signal to the RF in on the Sam.
2) Connect the video vert on the Sam to the vertical on the scope at .1 V per division.
3) Adjust R27 for 85% scope reading on the video portion of the signal.
4) This signal should be .1 V out of DC level and be .7 cm high with the peaks touching .1 V and .8 V respectively.

XIV. Spurs

1) Turn the +10 dB gain potentiometer on the front panel all the way clockwise and set the attenuator to the lowest scale (-20dB).
2) Tune the Sam from 4.0 MHz to the highest frequency of your meter, you shouldn't see any meter deflection.

XV. Voltmeter

1) Place function switch to the voltmeter position.
2) Connect AC and DC voltage, they should be ±3%.

XVI. Frequency Accuracy

1) Connect MC50 or meter calibrator to RF in on Sam at 150 MHz at +20 dBmV.
2) Tune in Sam for reading at 150 MHz with AFC off. If the signal does not peak, repeak R.F.
3) Tune in Sam now with AFC on, the needle should not move. If it moves down, tune the blue slug of the MX1 discriminator until the needle peaks.

4) If the needle moves up when you try to peak on the signal, turn AFC off and peak on signal at 150 MHz at +20 dBmV, then turn AFC on again. Do not try to repeak the Sam. At this time repeak the R.F. tuning caps on the R.F. assembly.

XVII Charging Circuit

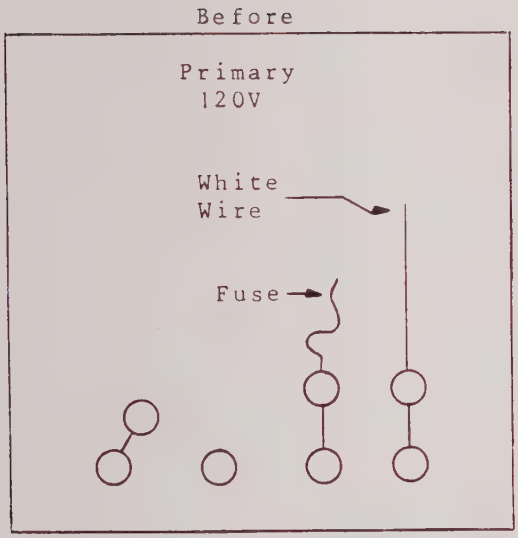
1) With the Sam connected to an external power supply, it will consume approximately 300 mA, this is with the light switch on and the volume turned fully on.
2) Plug in the AC charge plug to the Sam, observe the power supply-the current should drop to approximately 150 mA. At this time both the inside charge light and the front panel charge light should be aluminating.

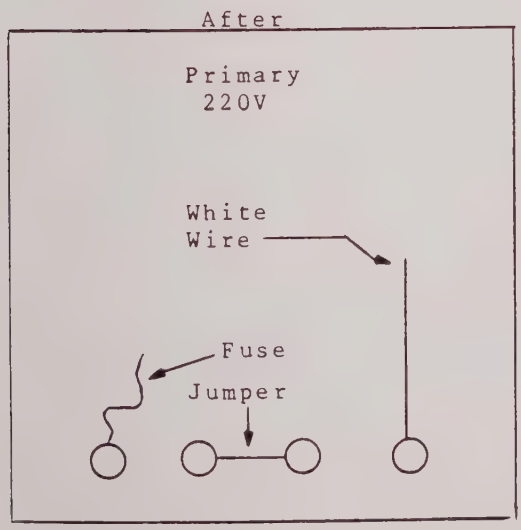
XVIII. Calibrator

1) Connect a cable from a frequency counter to the calibrator out on the Sam.
2) Adjust L11 on the Sam mainboard for 150 MHz ±.1 MHz.
3) Adjust R102 for +20 dBmV on the meter.

Sam Conversion From 120V to 220V

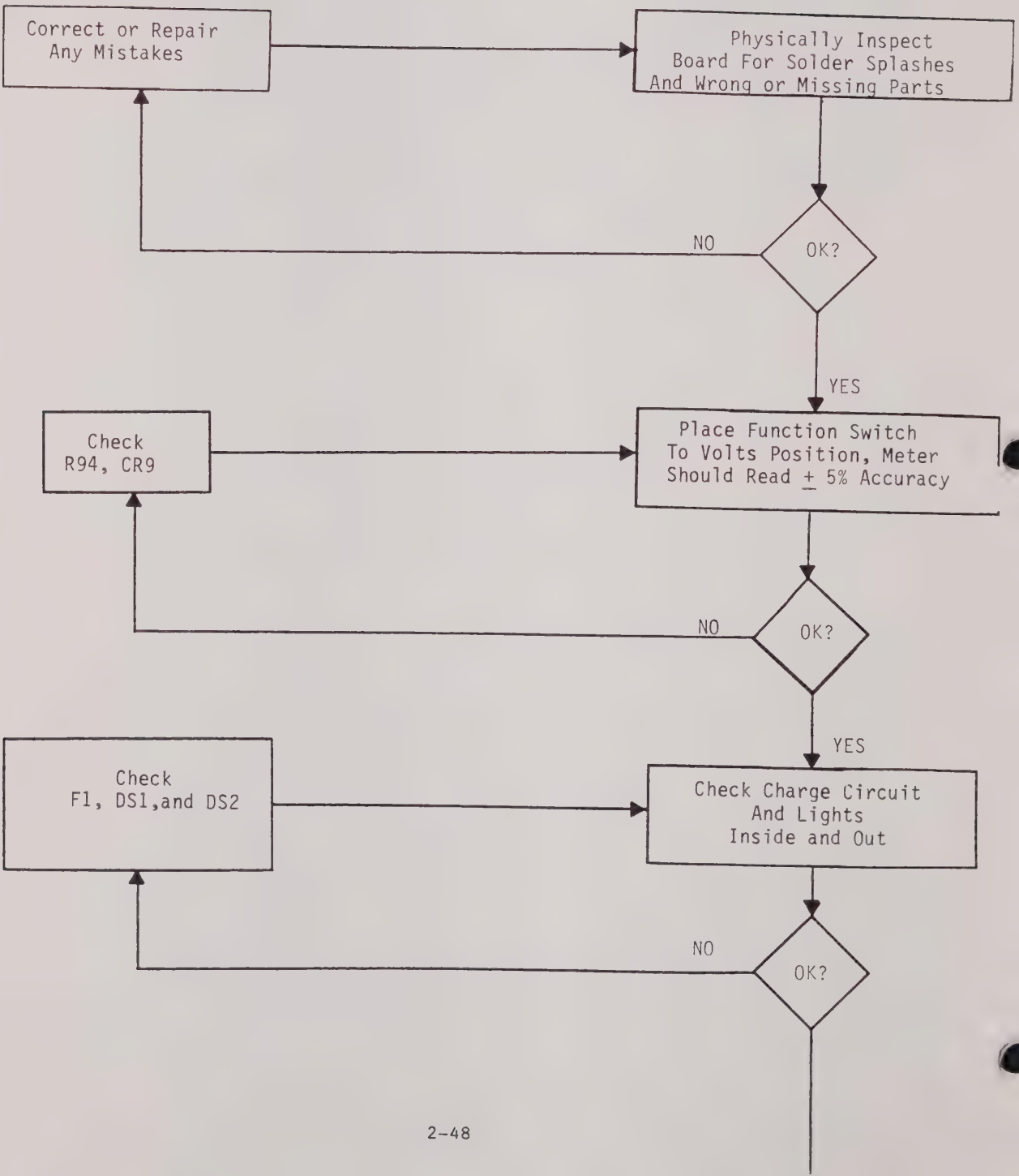
(Charge Circuit)

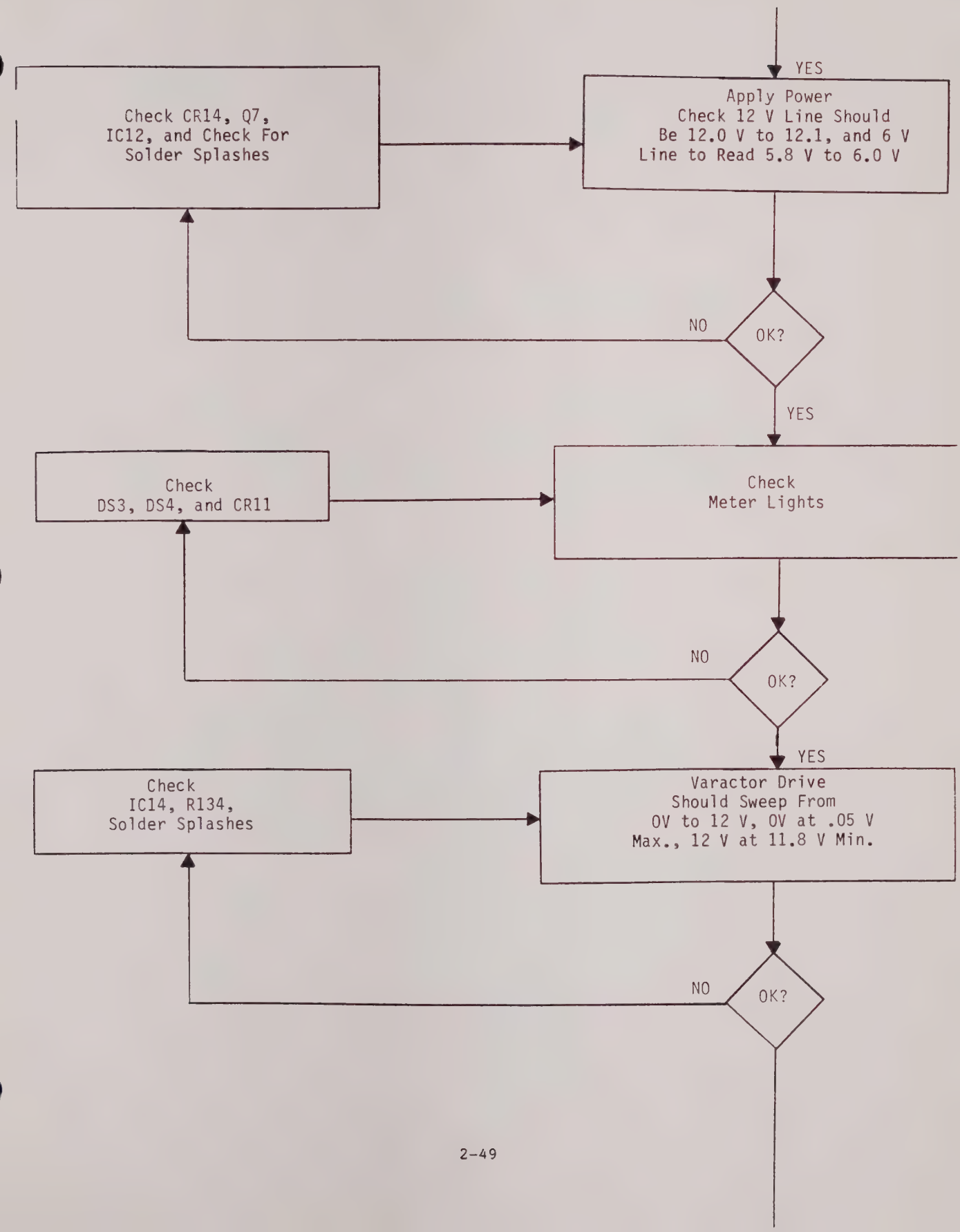


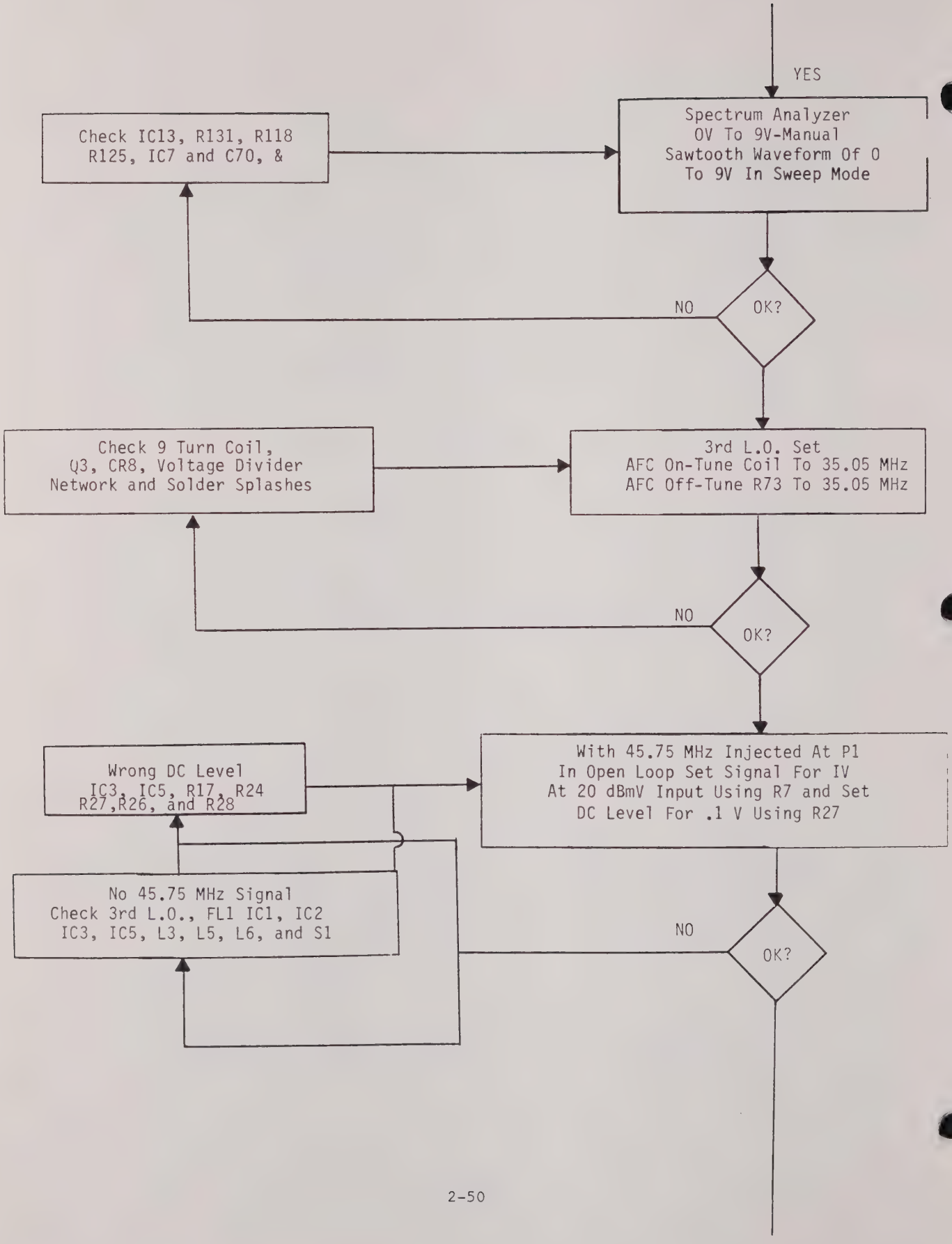


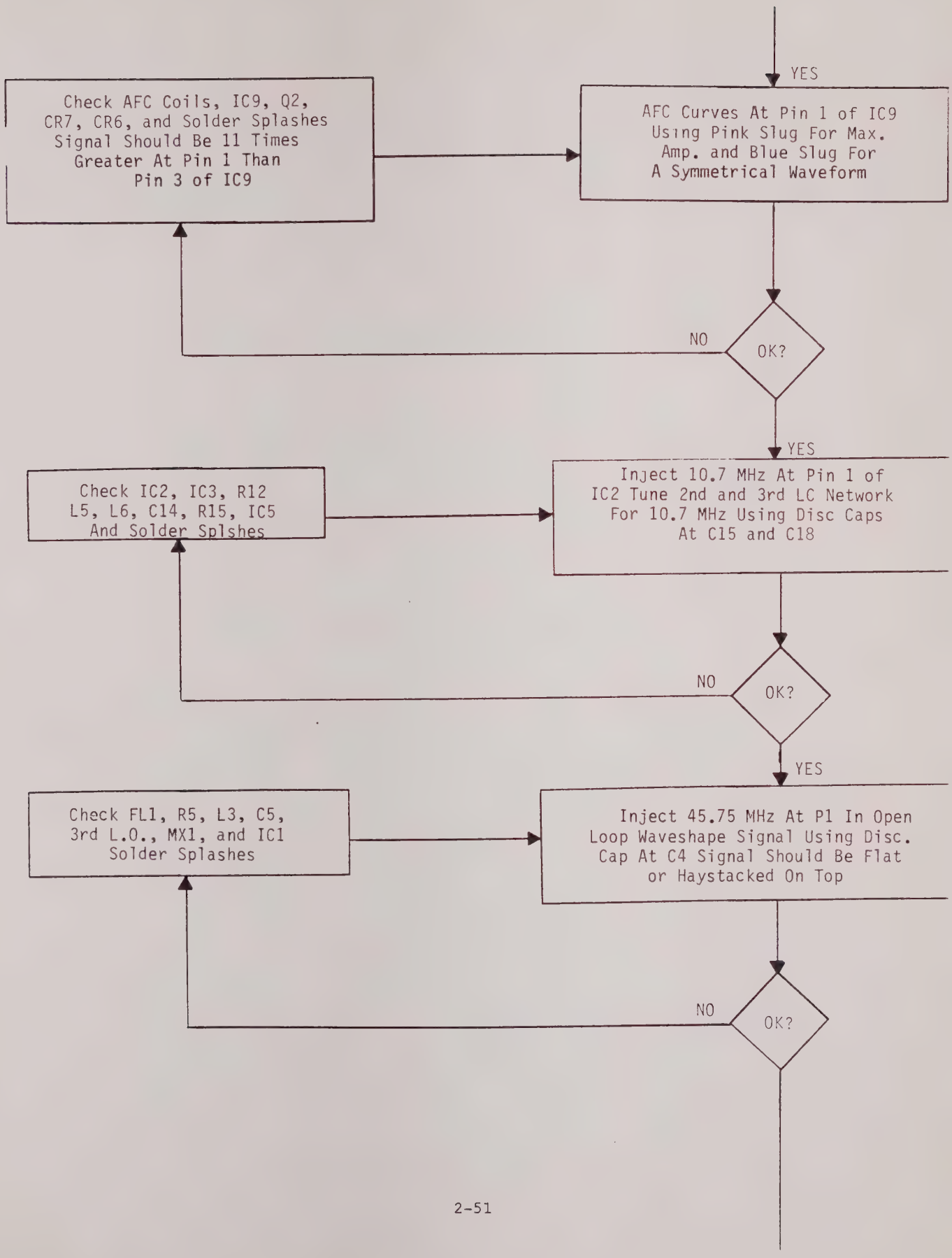
SAM MAIN BOARD

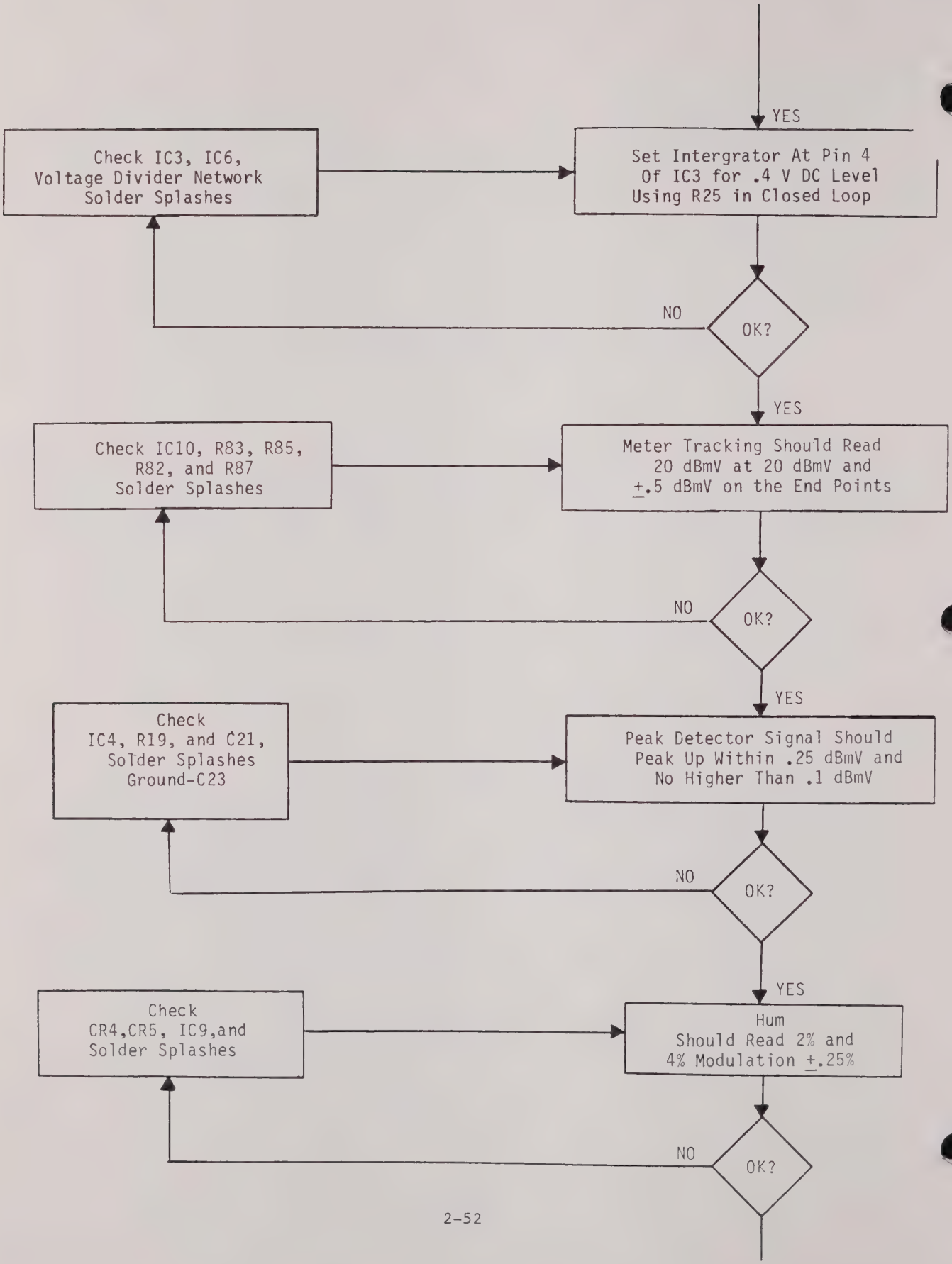
(Troubleshooting)

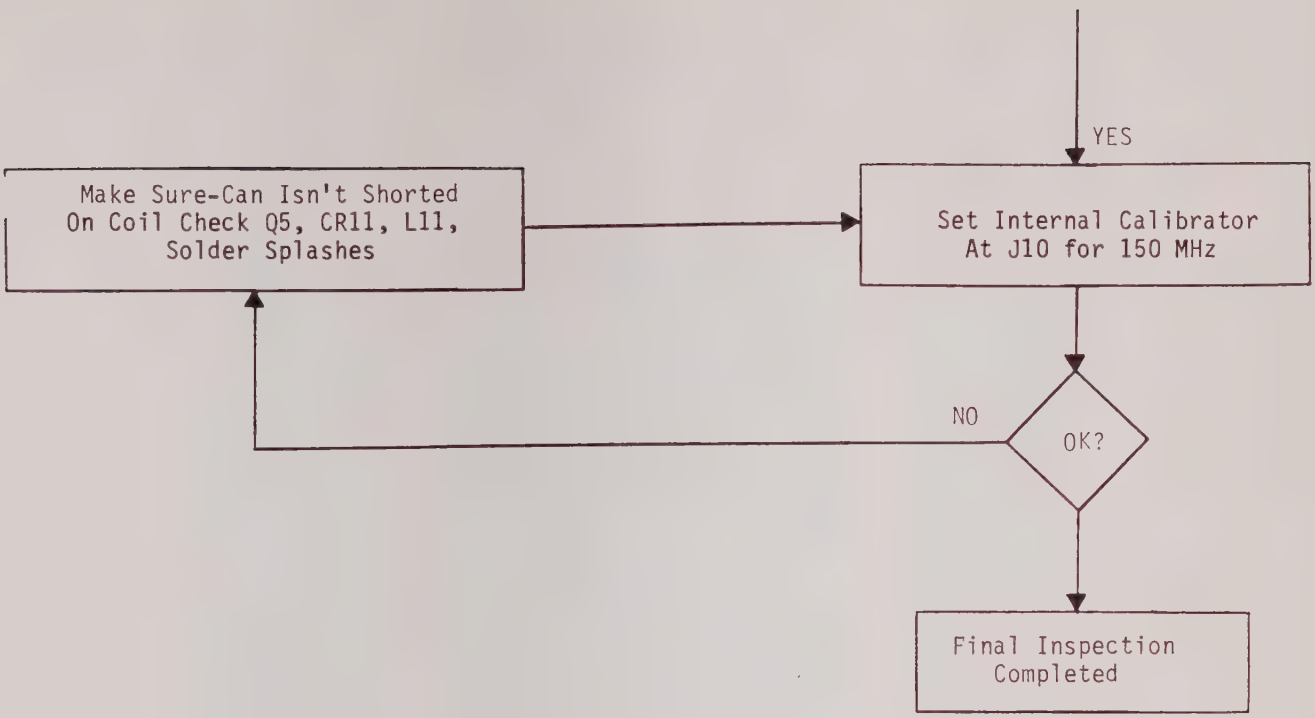



YES
Apply Power
Check 12 V Line Should
Be 12.0 V to 12.1, and 6 V
Line to Read 5.8 V to 6.0 V
Check CR14, Q7,
IC12, and Check For
Solder Splashes
NO
OK?
YES
Check
Meter Lights
Check
DS3, DS4, and CR11
NO
OK?
YES
Varactor Drive
Should Sweep From
0V to 12 V, 0V at .05 V
Max., 12 V at 11.8 V Min.
Check
IC14, R134,
Solder Splashes
NO
OK?


YES
Spectrum Analyzer
OV To 9V-Manual
Sawtooth Waveform Of 0
To 9V In Sweep Mode
Check IC13, R131, R118
R125, IC7 and C70, &
NO
OK?
3rd L.O. Set
AFC On-Tune Coil To 35.05 MHz
AFC Off-Tune R73 To 35.05 MHz
Check 9 Turn Coil,
Q3, CR8, Voltage Divider
Network and Solder Splashes
NO
OK?
With 45.75 MHz Injected At P1
In Open Loop Set Signal For IV
At 20 dBmV Input Using R7 and Set
DC Level For .1 V Using R27
Wrong DC Level
IC3, IC5, R17, R24
R27,R26, and R28
No 45.75 MHz Signal
Check 3rd L.O., FL1 IC1, IC2
IC3, IC5, L3, L5, L6, and S1
NO
OK?


YES
AFC Curves At Pin 1 of IC9 Using Pink Slug For Max. Amp. and Blue Slug For A Symmetrical Waveform
Check AFC Coils, IC9, Q2, CR7, CR6, and Solder Splashes Signal Should Be 11 Times Greater At Pin 1 Than Pin 3 of IC9
NO
OK?
YES
Inject 10.7 MHz At Pin 1 of IC2 Tune 2nd and 3rd LC Network For 10.7 MHz Using Disc Caps At C15 and C18
Check IC2, IC3, R12 L5, L6, C14, R15, IC5 And Solder Splshes
NO
OK?
YES
Inject 45.75 MHz At P1 In Open Loop Waveshape Signal Using Disc. Cap At C4 Signal Should Be Flat or Haystacked On Top
Check FL1, R5, L3, C5, 3rd L.O., MX1, and IC1 Solder Splashes
NO
OK?


YES
Set Intergrator At Pin 4
Of IC3 for .4 V DC Level
Using R25 in Closed Loop
Check IC3, IC6,
Voltage Divider Network
Solder Splashes
NO
OK?
YES
Meter Tracking Should Read
20 dBmV at 20 dBmV and
±.5 dBmV on the End Points
Check IC10, R83, R85,
R82, and R87
Solder Splashes
NO
OK?
YES
Peak Detector Signal Should
Peak Up Within .25 dBmV and
No Higher Than .1 dBmV
Check
IC4, R19, and C21,
Solder Splashes
Ground-C23
NO
OK?
YES
Hum
Should Read 2% and
4% Modulation ±.25%
Check
CR4,CR5, IC9,and
Solder Splashes
NO
OK?


YES
Make Sure-Can Isn't Shorted
On Coil Check Q5, CR11, L11,
Solder Splashes
Set Internal Calibrator
At J10 for 150 MHz
NO
OK?
Final Inspection
Completed

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
0412-00-0001	ASY DWG, SAM 1ST L.O.	1.000
0412-30-0004	ASY DWG, CHASSIS, SAM	1.000
0412-30-0008	ASY DWG, SAM I M.B.	1.000
0414-10-0001	SCH, SAM 1ST L.O.	1.000
0414-30-0026	SCH, MAIN BD, SAM I	1.000
1110-00-0410	METER BD, SAM I & II	1.000
1110-40-0018	FINAL ASSY, SAM I-450	1.000
1111-00-0114	CASE, SAM	1.000
1113-20-0050	ATTEN, 7570-05	1.000
1118-10-2013	ROTOR ASSY, 7570	1.000
1118-10-2106	F PLATE AY, 7570-05	1.000
1118-10-2227	ENCL ASSY, 7570-05	1.000
1118-10-2403	CONN KIT	1.000
1118-40-0003	DC BLOCK, SAM	1.000
1118-40-0021	FP ASY, SAM I-450-UHF	1.000
1118-40-0027	M.B. FINAL, SAM I	1.000
1210-32-0019	COIL, 4T	1.000
1210-42-0050	RF XFMR	1.000
1210-43-0007	COIL, 19T, 24GA	1.000
1216-00-0019	CHASSIS, SAM I	1.000
1216-00-0021	CHAS, RF AY, UHF	1.000
1216-40-0010	SAM CASE W/O BATT	1.000
1217-70-0069	CABLE ASSY, 5 1/2IN	1.000
1217-70-0070	CABLE ASSY, 7 1/2IN	1.000
1217-70-0071	CABLE ASSY, 6IN	1.000
1218-00-0100	OSC BD, SAM II-UHF	1.000
1218-40-0000	SAM 1ST L.O. PC ASSY	1.000
1218-40-0011	SAM I-450-UHF TUNING	1.000
1218-40-0015	MAIN BD PRELIM, SAM I	1.000
1219-00-0229	BATT ASSY, SAM	1.000
1219-00-0244	RF SUBAY 1-2, SAM-UHF	1.000
1219-00-0245	RF SUBAY 3-4, SAM-UHF	1.000
1219-00-0246	RF SUBAY 5-6, SAM-UHF	1.000
1219-00-0279	RF SUBAY 0, SAM-UHF	1.000
1219-00-0347	UHF SWITCH ASSY,	1.000
1219-00-0350	DIAL POT ASSY,	1.000
1219-40-0009	COIL KIT, SAM MAIN BD	1.000
1219-40-0010	HARNESS, SAMJR UHF RF	1.000
1219-40-0011	CABLE SET, SAM I	1.000
1219-40-0014	SAM SHIPPING KIT	1.000
1219-40-0054	MAIN BD FINAL PARTS	1.000
1219-40-0065	FP OPT KIT, SAM I-450	1.000
1410-01-1890	SAM LID LATCH BAR	1.000
1410-01-1960	SPEAKER GRILL 2 X 2	1.000
1410-01-1980	HUDSON CAN HU-5566	1.000
1410-01-1990	2 3/4"COLD ROLL ROD	1.000
1410-01-2000	ROD, 8 7/8"X1/4" DIA	1.000
1410-01-2010	DRUM, TAPPED,	2.000
1410-01-2030	GEAR, TAPPED,	2.000
1410-01-2160	ADAPTER FOR SAM PER B/P	1.000
1410-30-2200	SAM LID PLATE	1.000
1410-30-2210	SAM SPEAKER BRACKET	1.000
1410-30-2220	SAM RF LID COVER PER	1.000
1410-30-2240	SAM RIGHT ANGLE B/P	1.000
1410-30-2570	FISH PAPER PER B/P	1.000
1410-30-2600	HOLDER FOR SAM I &	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1410-80-0730	SAM WRAP AROUND PER	1.000
1410-80-0750	SAM RF METAL WORK	1.000
1410-80-1000	CAB SEAL, SAM,	1.000
1411-00-0160	FOLLOWER CAM	1.000
1411-00-0520	COUPLING	1.000
1411-00-0530	COUPLING	1.000
1411-00-0550	CONTACT PLATE	2.000
1411-00-0670	MOLD PLAS. ROTOR B/P	2.000
1411-00-1110	CONTACT	20.000
1411-00-1130	CONDUCTOR	1.000
1411-00-1820	WIPER CONTACT	2.000
1411-00-2080	BALL BEARING	2.000
1411-00-2090	DETENT SPRING	4.000
1411-00-2160	ENCLOSURE	1.000
1411-00-6260	SPACER PER B/P	1.000
1411-11-2820	COVER/STOP PL,	1.000
1411-11-2830	SHAFT, DETENT, PER B/P	1.000
1411-11-3440	NUT-REAR BEARING, PER B/P	1.000
1411-11-3560	FINGER CONTACT STRIP PER B/P	2.000
1411-11-3570	PLATE FRONT	1.000
1411-11-3591	COVER REAR	1.000
1411-11-3615	DETENT SHAFT PER B/P	1.000
1414-00-1002	COPPER TAPE 1610-02-0002	1.000
1414-00-1003	BUSHING,	1.000
1414-00-1013	BATTERY SUPPORTS	2.000
1414-00-1015	BRACKET, METER	1.000
1414-80-1007	SAMI-450-UHF F.PANEL	1.000
1510-00-1102	CAP, CHIP, 1000PF, 50V	7.000
1510-00-2750	CAP., CHIP 75PF 10%	1.000
1510-00-5470	CAP, CHIP, 47PF	2.000
1510-00-7501	CAP, CHIP, 500	1.000
1510-00-8569	CAP, CHIP, 5.6	2.000
1510-00-9102	CAP, CHIP, 1000	6.000
1510-10-0100	CAP, DISC, 1KV, 10PF	2.000
1510-10-0101	CAP, DISC, 1KV, 100PF	2.000
1510-10-0109	CAP, DISC, 1KV, 1PF	2.000
1510-10-0120	CAP, DISC, 1KV, 12PF	1.000
1510-10-0121	CAP, DISC, 1KV, 120PF	1.000
1510-10-0150	CAP, DISC, 1KV, 15PF	1.000
1510-10-0200	CAP, DISC, 1KV, 20PF	2.000
1510-10-0202	CAP, DISC, 1KV, 2PF	2.000
1510-10-0309	CAP, DISC, 1KV, 3PF	1.000
1510-10-0330	CAP, DISC, 1KV, 33PF	1.000
1510-10-0409	CAP, DISC, 1KV, 4PF	1.000
1510-10-0500	CAP, DISC, 1KV, 50PF	4.000
1510-10-0609	CAP, DISC, 1KV, 6PF	1.000
1510-10-0750	CAP, DISC, 1KV, 75PF	5.000
1510-10-1302	CAP, DISC, 1KV, .003UF	1.000
1510-10-3229	CAP, DISC, 1KV, 2.2PF	1.000
1510-10-7471	CAP, DISC, 50V, 470PF	4.000
1510-11-1154	CAP, DISC, 100V, .15UF	1.000
1510-12-0102	CAP, DISC, 1000PF	1.000
1510-12-1102	CAP, DISC, 1000PF	17.000
1510-12-2103	CAP, DISC, 80/20, .01MF	4.000
1510-12-2104	CAP, DISC, 80/20, .1MF	12.000
1510-12-2224	CAP, DISC, Z12V, .22MF	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1510-12-3331	CAP,DISC,330	3.000
1510-14-4103	CAP,MON,50V,.01UF	1.000
1510-23-4101	CAP,ELEC,25V,100UF	4.000
1510-23-5221	CAP,ELEC,16V,220UF	1.000
1510-23-7150	CAP,ELEC,25V,15UF	1.000
1510-23-9222	CAP,ELEC,16V,2200UF	1.000
1510-24-0229	CAP,TANT,25V,2.2UF	7.000
1510-25-1102	CAP,ELEC,50V,1000UF	1.000
1510-31-8501	CAP,FT,500PF	9.000
1510-40-0139	CAP,COMP,500V,1.3PF	3.000
1510-40-1119	CAP,COMP,500V,1.1PF	2.000
1510-40-1228	CAP,COMP,500V,.22PF	1.000
1510-40-1279	CAP,COMP,500V,2.7PF	1.000
1510-40-1518	CAP,COMP,500V,.51PF	1.000
1510-61-8474	CAP,MYLR,100V,.47UF	1.000
1510-61-9338	CAP,MYLR,200V,.33PF	1.000
1510-70-1030	CAP,VAR,.5-3PF	1.000
1510-71-2859	CAP,VAR,.8-8.5PF	2.000
1510-71-3100	CAP,VAR,10PF	2.000
1610-02-0002	TAPE,COPPER,1/4", (18YDS.PER RL)	1.840
1710-00-2350	PC BOARD, 080-044F FROM:3210-05-0052	1.000
1710-00-2360	PC BOARD, 080-048B	1.000
1710-00-3800	PC BOARD, 080-045C FROM:3210-05-0044	1.000
1714-00-0000	SAM IST L.O. PCB FROM:3210-05-0046	1.000
1714-00-0003	SAM I-450-UHF TUN BD FROM:3210-05-0045	1.000
1810-03-0278	CHOKE,COATED,.27UH	2.000
1810-06-0003	COIL,TAPPED,1:1-1/2	1.000
1810-06-0004	COIL,TAPPED,1:4	1.000
1810-10-0189	CHOKE,MOLDED,1.8 UH	6.000
1810-10-0220	CHOKE,MOLDED,22 UH	7.000
1811-04-0001	DISCRIMINATOR COIL	1.000
1813-00-0007	FERR. BEAD,LC000-009	6.000
1813-00-0033	COIL FORM	2.000
1813-00-0036	SLUG CORE	2.000
1813-00-0038	COIL MNTG. BASE	2.000
1813-00-0039	COILFORM	1.000
1813-00-0052	FERRITE SLEEVE	1.000
1813-00-0053	BALUN CORE	1.000
1815-00-0017	COIL,4-1/2T,#22	1.000
2110-00-0001	ADPTR,F-F/F-F,1.13	2.000
2110-01-1001	CONN,BNC-F,75,FLANGE	2.000
2110-01-1002	CONN,BNC-F,75,FLANGE	2.000
2110-06-0001	CONN.,F	2.000
2110-06-0004	ADPTR,F-F/F-F,.80	1.000
2110-06-1005	CONN,F,W/HDWR	5.000
2111-00-0007	NUT, BANANA JACK	1.000
2112-01-0005	JACK,BANANA,RD	1.000
2112-01-0006	JACK,BANANA,BK	1.000
2112-03-0024	TERM,LCKNG,3/8IN	3.000
2112-03-0026	SOLDER LUG	1.000
2112-05-0006	CONN.,MALE 5-PIN	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
2112-05-0010	CONN.,MALE,2-PIN	1.000
2112-05-0013	CONN,PLUG,8-PIN LOCK	1.000
2112-12-0005	PHONO JACK	1.000
2112-12-0006	PLUG,PHONO,LONG	1.000
2112-16-0011	CARD GUIDE,4 IN	2.000
2112-32-0001	AC RECEPTACLE,EUR,6A	1.000
2112-32-0003	PLUG,BATTERY,10-12IN	1.000
2112-33-0003	FEED THRU,HERMETIC, PER B/P	1.000
2113-06-0004	KONEKTON,4-CKT	1.000
2113-06-0008	JACK,FEMALE,5-CKT	1.000
2113-06-0014	CONN,FEMALE,2-PIN	2.000
2113-07-0001	CONTACT MC000-068	5.000
2113-07-0002	CONTACT,MC000-131	13.000
2410-01-0034	KNOB,BLK,1/8-IN	2.000
2410-01-0035	KNOB,BLK,1/4-IN	2.000
2410-01-0039	KNOB W/8-32 SET	3.000
2410-01-0042	KNOB,3.5CLR DIAL	1.000
2410-02-0006	LAMP	1.000
2410-02-0007	LAMP,WH,14V	1.000
2410-02-0008	LAMP	2.000
2410-04-0001	DECAL,SER.NO.	2.000
2410-04-0463	DECAL, ATTEN DRUM	2.000
2410-04-0564	DECAL,SAM CAL	1.000
2410-05-0018	FUSE,1A,250V,QUICK	1.000
2410-06-0022	METER,SAM	1.000
2411-04-0002	DECAL,7570-5 ATTEN	1.000
2414-04-0006	DECAL,BATT CHG,SAM	1.000
2414-14-0002	DECAL,SAM GUARANTEE	1.000
2414-24-0001	DECAL,SAM I-450 HRC	2.000
2710-02-0002	FILTER,SFE,10.7MA	1.000
2810-00-0007	CABLE CLAMP,3/16	1.000
2810-02-6106	SPACER,6-32X3/8	2.000
2810-10-0034	RUBBER GROMMET	2.000
2810-10-0035	GROMMET,RBBR,3/16	1.000
2810-12-0035	LATCH,ARROWHEAD	1.000
2810-12-0036	ROLLER,NYLON STD.	2.000
2810-12-0037	GEAR,NYLON	2.000
2810-12-0038	3/4IN CLIP AND	4.000
2810-12-0070	LOUVER,SCRN,1 IN DIA	1.000
2810-14-4100	NUT,4-40,HN101-400	2.000
2810-15-0001	NUT,HEX,3/8-32X1/2AF	7.000
2810-15-0006	NO.8 FLEX LOC NUT,ZP	4.000
2810-16-0018	NUT,HEX 6-32X5/16,ZP	4.000
2810-16-0019	NUT,HEX,4-40X1/4X	2.000
2810-17-2104	SCW,SBH,2-56X1/4	1.000
2810-17-4106	SCW,SBH,4-40X3/8	4.000
2810-17-8104	SCW,SBH,8-32X1/4	1.000
2810-17-8106	SCW,SBH,8-32X3/8	5.000
2810-23-0031	SCREW,PAN HD,BLK,	6.000
2810-23-0034	SCREW,SWG,PAN,PHIL	22.000
2810-23-0035	SCREW,PAN HD.,	10.000
2810-23-0037	SCW,SLT HEX WSHR HD	6.000
2810-23-0043	SCREW,PAN HD,	4.000
2810-24-4000	LO,WASHER,INT,4	1.000
2810-24-6000	INT,LOWASHER,6	3.000
2810-25-6000	LWASHER,EXT,6	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
2810-26-0012	WSHR,SPCR,6,.140ID	2.000
2810-28-0003	LW,INT,SPEC,3/8 ID	5.000
2810-28-0010	WASHER,5804-43-1	1.000
2810-28-0041	WASHER,FLAT	7.000
2810-28-0051	WASHER,SPRING,.439ID	2.000
2810-30-0011	RIVET	6.000
2810-32-0002	SHAFT COUPLING	2.000
2810-32-0003	COULPER,4 HL, PER B/P	1.000
2810-42-4102	ST SCRW,SKT,4-40X1/8	1.000
2810-42-4103	SS,KN,CUP,4-40X3/16	1.000
2810-42-4106	SET SCREW,SKT,CUP PT	1.000
2810-42-6103	SOCKET SET SCREW CUP POINT	6.000
2810-43-6103	ST SCREW,CONE,SKT	6.000
2810-45-0003	FLANGED BEARING	3.000
2810-56-2103	SCW,PFIL,2-56X3/16	18.000
3010-11-0002	SPKR,2-1/4 45 OHM	1.000
3010-12-0009	CASE	1.000
3010-54-0004	MIXER,DBL.BAL.	1.000
3010-54-0005	MIXER,DBL.BAL.	1.000
3210-05-0044	G-10FR,1/16X12X16	0.083
3210-05-0045	G-10FR,1/16X10X12	0.500
3210-05-0046	G-10FR,1/16X12X16	0.025
3210-05-0052	G-10FR,1/16X12X18,	0.500
4010-00-0013	BATTERY PACK,SAM	1.000
4610-01-4101	POT,100	3.000
4610-01-4102	POT,1K	1.000
4610-01-4103	POT,10K	3.000
4610-01-4202	POT,2K	2.000
4610-01-4203	POT,20K	2.000
4610-01-4204	POT,200K	2.000
4610-01-5202	POT.,2K	22.000
4610-14-5102	POT,1K	1.000
4610-14-6253	POT,25K	1.000
4610-14-8253	POT,25K	1.000
4610-31-1102	POT/SWITCH,1K	1.000
4610-31-2103	POT/SWITCH,10K	1.000
4610-31-4103	POT/SWITCH,10K	1.000
4610-40-4106	POT,DUAL,1M,10K	1.000
4700-05-1000	RES,C,1/8W,5%,100	2.000
4700-05-1509	RES,C,1/8W,5%,15	2.000
4700-05-2000	RES,C,1/8W,5%,200	1.000
4700-05-3901	RES,C,1/8W,5%, 3.9K	1.000
4700-05-6800	RES,C,1/8W,5%,680	1.000
4700-15-1000	RES,C,1/4W,5%,100	1.000
4700-15-1001	RES,C,1/4W,5%,1K	11.000
4700-15-1002	RES,C,1/4W,5%,10K	21.000
4700-15-1003	RES,C,1/4W,5%,100K	10.000
4700-15-1004	RES,C,1/4W,5%,1M	1.000
4700-15-1009	RES,C,1/4W,5%,10	3.000
4700-15-1201	RES,C,1/4W,5%,1.2K	4.000
4700-15-1500	RES,C,1/4W,5%,150	4.000
4700-15-1501	RES,C,1/4W,5%,1.5K	3.000
4700-15-1502	RES,C,1/4W,5%,15K	2.000
4700-15-1503	RES,C,1/4W,5%,150K	1.000
4700-15-1801	RES,C,1/4W,5%,1.8K	2.000
4700-15-2002	RES,C,1/4W,5%,20K	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4700-15-2200	RES,C,1/4W,5%,220	1.000
4700-15-2201	RES,C,1/4W,5%,2.2K	4.000
4700-15-2202	RES,C,1/4W,5%,22K	7.000
4700-15-2203	RES,C,1/4W,5%,220K	1.000
4700-15-2402	RES,C,1/4W,5%,24K	2.000
4700-15-2700	RES,C,1/4W,5%,270	1.000
4700-15-2701	RES,C,1/4W,5%,2.7K	6.000
4700-15-2702	RES,C,1/4W,5%,27K	2.000
4700-15-2708	RES,C,1/4W,5%,2.7	1.000
4700-15-3300	RES,C,1/4W,5%,330	1.000
4700-15-3301	RES,C,1/4W,5%,3.3K	3.000
4700-15-3901	RES,C,1/4W,5%,3.9K	2.000
4700-15-3902	RES,C,1/4W,5%,39K	1.000
4700-15-4301	RES,C,1/4W,5%,4.3K	1.000
4700-15-4700	RES,C,1/4W,5%,470	7.000
4700-15-4701	RES,C,1/4W,5%,4.7K	2.000
4700-15-4702	RES,C,1/4W,5%,47K	1.000
4700-15-4703	RES,C,1/4W,5%,470K	1.000
4700-15-4709	RES,C,1/4W,5%,47	1.000
4700-15-5609	RES,C,1/4W,5%,56	1.000
4700-15-6201	RES,C,1/4W,5%,6.2K	1.000
4700-15-6202	RES,C,1/4W,5%,62K	2.000
4700-15-6800	RES,C,1/4W,5%,680	1.000
4700-15-6801	RES,C,1/4W,5%,6.8K	2.000
4700-15-6803	RES,C,1/4W,5%,680K	1.000
4700-15-6804	RES,C,1/4W,5%,6.8M	1.000
4700-15-7509	RES,C,1/4W,5%,75	2.000
4700-15-8201	RES,C,1/4W,5%,8.2K	5.000
4700-15-8202	RES,C,1/4W,5%,82K	1.000
4700-15-9101	RES,C,1/4W,5%,9.1K	1.000
4700-15-9109	RES,C,1/4W,5%,91	2.000
4701-03-1002	RES,MF,1/8W,1%,10K	4.000
4701-03-1132	RES,MF,1/8W,1%,11.3K	1.000
4701-03-1282	RES,MF,1/8W,1%,12.8K	1.000
4701-03-1302	RES,MF,1/8W,1%,13.0K	3.000
4701-03-1472	RES,MF,1/8W,1%,14.7K	3.000
4701-03-1502	RES,MF,1/8W,1%,15K	1.000
4701-03-1622	RES,MF,1/8W,1%,16.2K	4.000
4701-03-1823	RES,MF,1/8W,1%,182K	2.000
4701-03-2373	RES,MF,1/8W,1%,237K	1.000
4701-03-2802	RES,MF,1/8W,1%,28.0K	1.000
4701-03-3012	RES,MF,1/8W,1%,30.1K	1.000
4701-03-3403	RES,MF,1/8W,1%,340K	2.000
4701-03-4871	RES,MF,1/8W,1%,4.87K	1.000
4701-03-8061	RES,MF,1/8W,1%,8.06K	2.000
4701-03-9091	RES,MF,1/8W,1%,9.09K	2.000
4701-13-1003	RES,MF,1/4W,1%,100K	1.000
4705-05-1000	RES,C,1/8W,5%,100	1.000
4705-05-1002	RES,C,1/8W,5%,10K	2.000
4705-05-1209	RES,C,1/8W,5%,12	2.000
4705-05-1509	RES,C,1/8W,5%,15	1.000
4705-05-2200	RES,C,1/8W,5%,220	1.000
4705-05-2202	RES,C,1/8W,5%,22K	3.000
4705-05-2700	RES,C,1/8W,5%,270	1.000
4705-05-3000	RES,C,1/8W,5%,300	2.000
4705-05-3900	RES,C,1/8W,5%,390	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4705-05-4301	RES, C, 1/8W, 5%, 4.3K	1.000
4705-05-9101	RES, C, 1/8W, 5%, 9.1K	1.000
4705-15-3301	RES, C, 1/4W, 5%, 3.3K	1.000
4741-10-7008	RES, L-A, 1/4W, 1%, 107	6.000
4741-11-8009	RES, L-A, 1/4W1%, 1.18K	2.000
4741-14-3008	RES, L-A, 1/4W, 1%, 143	4.000
4741-20-5008	RES, L-A, 1/4W, 1%, 205	2.000
4741-21-0009	RES, L-A, 1/4W1%, 2.10K	2.000
4741-26-7008	RES, L-A, 1/4W, 1%, 267	4.000
4741-37-4008	RES, L-A, 1/4W, 1%, 374	2.000
4741-45-3007	RES, L-A, 1/4W, 1%, 45.3	2.000
4741-66-5008	RES, L-A, 1/4W, 1%, 665	2.000
4741-76-8007	RES, L-A, 1/4W, 1%, 76.8	4.000
4741-80-6007	RES, L-A, 1/4W, 1%, 80.6	4.000
4741-84-5007	RES, L-A, 1/4W, 1%, 84.5	4.000
4741-90-9007	RES, L-A, 1/4W, 1%, 90.9	4.000
4801-01-0825	DIODE, ZENER, 6.2V	1.000
4801-01-5231	DIODE, ZENER, 5.1V	1.000
4803-02-0011	DIODE, VARACTOR	5.000
4803-02-0020	DIODE, VARACTOR	2.000
4806-01-4007	DIODE, RECT, 1000V	1.000
4806-02-0005	DIODE BRIDGE	1.000
4807-01-0034	DIODE, GE PT CONTACT	4.000
4807-01-0082	DIODE, SI PT CONTACT	1.000
4807-01-0914	DIODE, SIGNAL	6.000
4810-02-0007	LED, RD, W/BEZEL	1.000
4901-04-3030	TRANSISTOR	1.000
4901-04-4160	JFET, N-CHANNEL	2.000
4901-05-1791	TRANSISTOR, NPN,	5.000
4902-00-0320	TRANSISTOR, POWER	1.000
4902-00-0901	TRANSISTOR, MOT ONLY	1.000
4902-00-0911	TRANSISTOR, MOT ONLY	1.000
4902-00-9110	TRANSISTOR, RF	1.000
4902-04-0490	TRANSISTOR, PNP	1.000
4999-00-0007	TRANSISTOR	1.000
5104-00-0034	SWITCH, ROTARY	1.000
5104-00-0035	SWITCH, ROTARY	1.000
5105-00-0017	SWITCH, SLIDE	1.000
5106-00-0021	SWITCH, TOGGLE, W/HDWR	2.000
5106-00-0023	SWITCH, TOGGLE, SPDT	1.000
5106-00-0024	SWITCH, TOGGLE, SPDT	1.000
5106-00-0028	SWITCH, TOGGLE	1.000
5610-00-0043	TRANSFORMER	1.000
6010-72-4000	WIRE, MAGNET, 24GA.	24.000
6010-72-8000	WIRE, MAGNET, 28GA.	0.600
6010-73-2000	WIRE, MGNT, 32GA, GN	4.000
6010-73-4000	MAGNET WIRE, 34 GA.,	0.330
6010-91-4000	WIRE, BUS, 14 GA	2.500
6010-91-8000	WIRE, BUSS, 18 GA.	10.000
6011-20-2000	SLEEVING, SHRINKABLE,	4.500
6011-20-4000	SLEEVING, SHRINKABLE,	8.000
6011-40-0001	CABLE, SUBMINAX, 75	6.500
6011-40-0008	CABLE, RG174/U,	6.750
6011-40-0012	CABLE, 59/U, DBL SHLD	14.000
6011-60-0006	LINE CORD, 3-COND, SVT	1.000
6012-00-0001	TEST LEADS	1.000

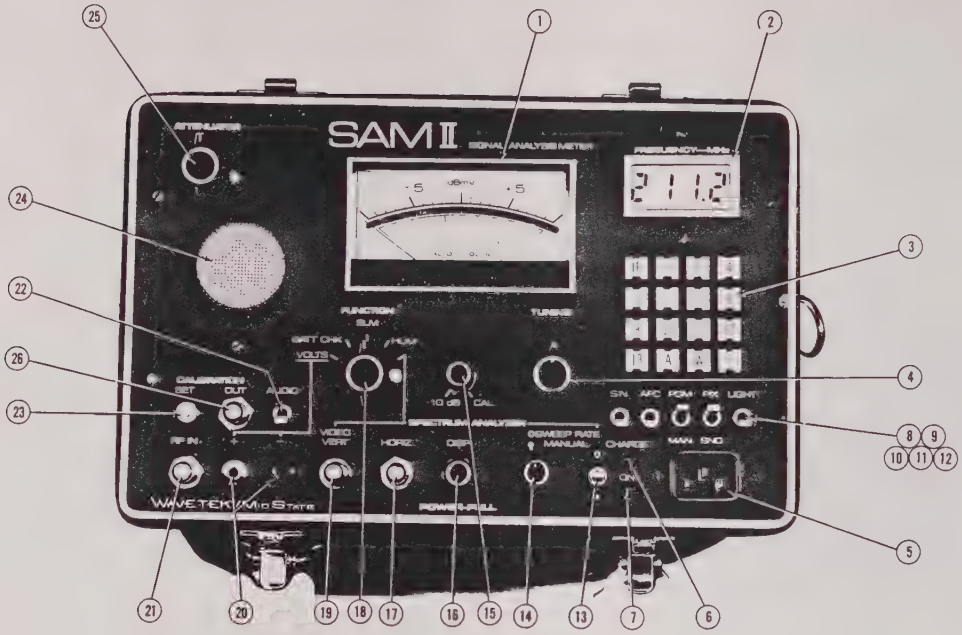
-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
6012-12-2555	WIRE,22,GN	7.750
6012-12-2889	WIRE,22,GY/WH	8.000
6012-12-2993	WIRE,22,WH/OR	7.500
6012-12-2996	WIRE,22,WH/BL	2.000
6012-12-2999	WIRE,22,WH	7.750
6012-52-4000	WIRE,MAGNET,24GA.	2.000
6510-00-0035	HANDBOOK,SAM SER	1.000
7000-03-2400	QUAD OP AMP	3.000
7000-03-8000	AUDIO POWER AMP	1.000
7000-13-3000	DETECTOR/BUFFER	1.000
7000-13-5000	IF AMP	2.000
7000-14-5800	DUAL OP AMP	3.000
7000-14-5801	DUAL OP AMP,MOT	1.000
7000-31-6000	WIDE-BAND OP AMP	5.000

401 records listed.

SAM II INTRODUCTION

The Sam II's many features enable it to perform many more functions than a normal field strength meter. Every circuit has been evaluated for temperature and current consumption. The frequency is controlled by depressing a button on the keyboard. Once the button is depressed the meter will tune to the desired frequency. The frequencies are preprogrammed to the cable systems needs. The 16 button keyboard and PIX/SND switch provide capability for digitally tuning 32 preprogrammed frequencies. When a button is depressed the meter will tune to that frequency and display it on the L.C.D. readout. This meter also has manual tuning. When the PGM/MAN switch is in the manual position, the meter is capable of manually tuning anywhere in its range.

FRONT PANEL, MODEL SAM II

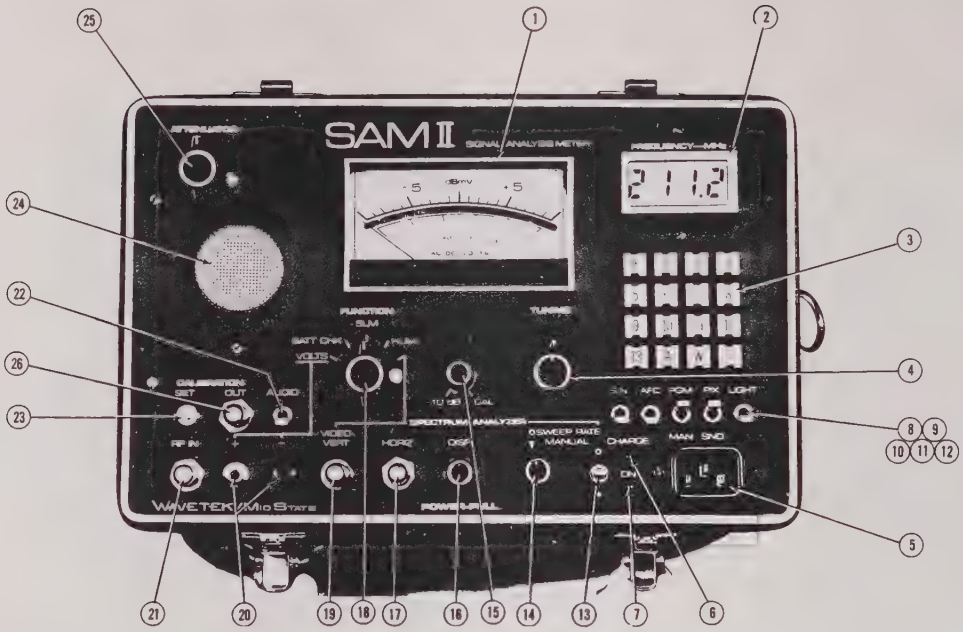


ITEM	DESCRIPTION	PART NUMBER
1	Meter Bezel	2410-08-0010
2	L.C.D. Display	2410-03-0006
3	Keyboard	5108-00-0003
4	Course Tuning Knob (new style)	2410-01-0038
5	AC Recepticle	2112-32-0006
6	Charge Light	2410-02-0007
7	On "LED"	4810-02-0007
8	Light Switch	5106-00-0021
9	PIX/SND Switch	5106-00-0022
10	AFC Switch	5106-00-0021
11	PGM/MAN Switch	5106-00-0025
12	Signal to Noise Switch	5106-00-0020
13	Sweep Rate/Manual Switch	4610-40-4106
14	Sweep Rate/Manual Knob	2410-01-0040
15	Gain Knob	2410-01-0035
16	Disp/Power Knob	2410-01-0035
17	Horizontal Connector	2110-06-1005
18	Function Switch Knob	2410-01-0039
19	Video Vert. Connector	2110-06-1005
20	Banana Jacks	
	a) Positive	2112-01-0005
	b) Negative	2112-01-0006
21	RF In Connector	2110-00-0001
22	Audio Knob	2410-01-0034
23	Calibration Set Control	4610-14-8253
24	Speaker Grill	1410-01-1960
25	Attenuator Knob	2410-01-0039

SPECIFICATIONS FOR MODEL SAM II

SIZE	7" high x 11" wide x 10" deep
WEIGHT	11 lbs.
BATTERY	Rechargeable Nickle Cadmium Typically have 8 hours, continuous operation.
AC POWER REQUIREMENTS Charging only	110 VAC ± 10% (220 VAC ± 10% optional); 50 to 60 Hz; 20 W
AMPLITUDE RANGE	-40 to +60 dBmV
AMPLITUDE ACCURACY	± .5 dB
TEMPERATURE RANGE	0 to 120° F
TEMPERATURE ACCURACY	± 1 dB
FREQUENCY RANGES	4 to 300 MHz 4 to 400 MHz Accuracy ±.1 MHz 470 to 890 MHz
SELECTIVITY	Sufficient to distinguish between two FM signals of equal amplitude 400 kHz apart. Sufficient to measure an audio carrier in the presence of an upper channel video carrier 40 dB greater than the sound carrier.
I.F. BANDWIDTH	280 kHz at 3 dB, 600 kHz at 40 dB point
HUM	0.5% to 5%
CALIBRATOR Frequency Amplitude	 150 MHz ±.1 MHz +20 dBmV ±.25 dB over temperature range
VOLTMETER	5 - 100 AC-DC 10%
SPECTRUM ANALYZER Amplitude Range Frequency Range Rate Dispersion Horizontal Vertical	 40 dB on screen; -40 dBmV to +60 dBmV 4 MHz to 300 MHz or 4 MHz to 400 MHz Variable 2 Hz to 40 Hz, plus manual. Variable from .15 MHz +.5 to +9 V 0-3 V
S/N	@63 MHz ± 1 dB from 21.6 dB (factory test with calibrated noise source spec)
PEAK DETECTOR	-.2 dB
AFC	Amplitude of signal must pull up with in ±5 dB of peak from at lest 5 dB down

OPERATOR CONTROLS FOR MODEL SAM II



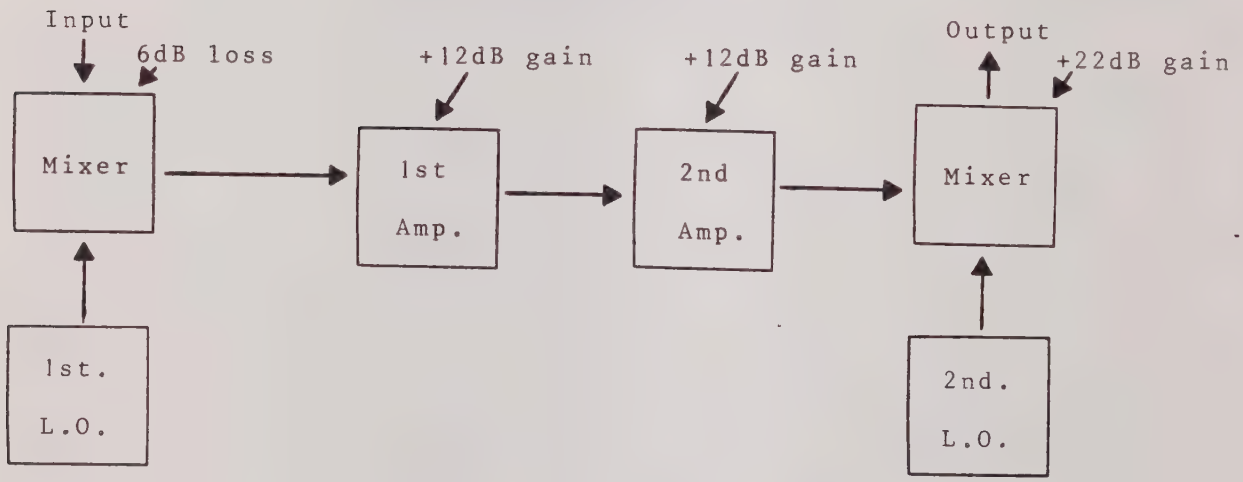
1	METER SCALES	for dBmV, % hum and AC-DC volts.
2	DIGITAL FREQUENCY DISPLAY	indicates frequency selected.
3	KEYBOARD	Selects channels to be measured.
4.	TUNING	Conventional coarse and fine tuning.
5.	S/N	Used to compensate noise readings.
6.	PGM/MAN	Selects manual tuning or keyboard tuning.
7.	AFC	Energizes AFC circuit to aid meter peaking.
8.	PIX/SND	Selects A or B function on keyboard
9.	LIGHT	Illuminates meter.
10.	JACK	110 VAC input to charge circuit.
11.	CHARGE	Indicates battery being charged.
12.	ON	Indicates Sam is turned on.
13.	MANUAL/RATE SWITCH	Selects between manual sweep and recurrent sweep
14.	SWEEP RATE/MANUAL	Rear control, spectrum sweep rate. Front control, spectrum manual rate.
15.	GAIN	Provides 10 dB variable gain.
16.	POWER-PULL-ON-OFF SWITCH	Pull to energize unit. This control also functions as the dispersion control for the spectrum analyzer.

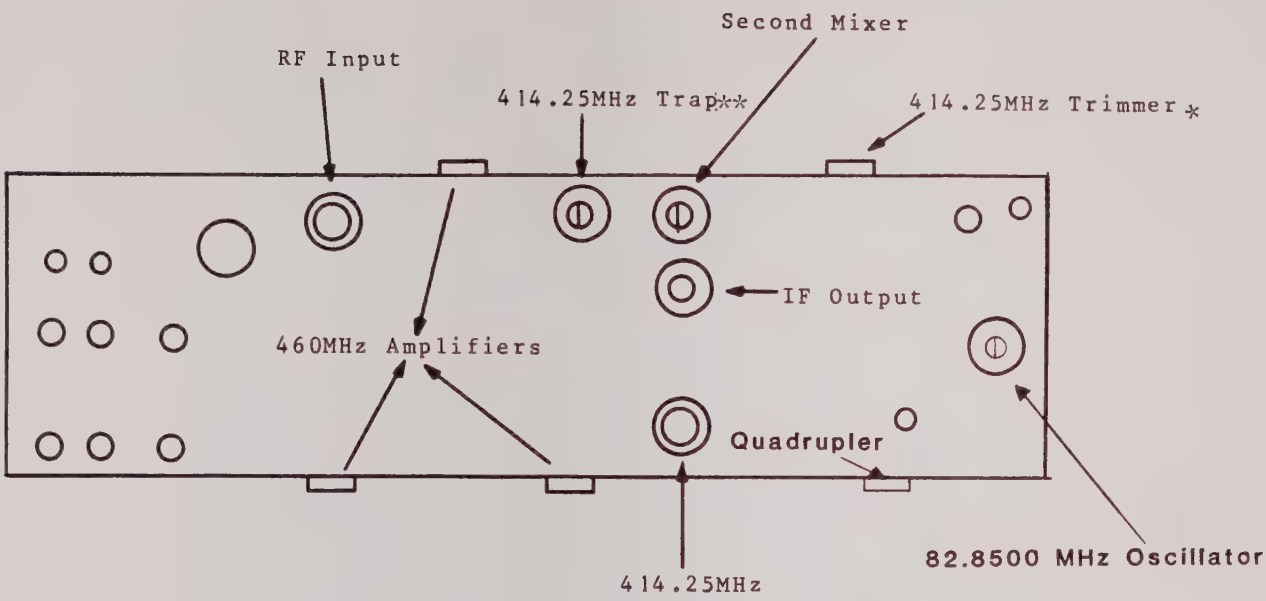
17. HORIZONTAL -	Sweep ramp output for the analyzer.
18. FUNCTION -	Selects meter mode, i.e., level, hum, etc.
19. VIDEO/VERT	Video output and scope vertical for the analyzer.
20. + AND -	Voltmeter input jacks.
21. RF IN	Input jack for signals to be measured.
22. AUDIO	Energizes internal audio circuit.
23. SET	Calibration Control for signal level meter function.
24. OUT	Internal calibrator output signal.
25. SPEAKER	For monitoring audio information
26. ATTENUATOR	Sets input range and changes meter scale to identify proper range.

R.F. ASSEMBLY

The R.F.assembly is a frequency converter which converts all tuning ranges of the Sam to a common output of 45.75 MHz. The I.F. consists of a 1st L.O. which uses varactor tuning to feed the mixer with the incoming signal. The output of the mixer is 460 MHz. Two stages of I.F. amplification follow the mixer with about +12 dB of gain each. This amplified 460 MHz signal is then fed to another mixer circuit which is coupled to the 2nd L.O. (414.25) for a common output frequency of 45.75 MHz and is connected to the input of the main board I.F.

Some units have UHF coverage by using an added UHF tuning board (1st L.O.). Also, the 2nd L.O. maybe crystal controlled, rather than the standard tuneable oscillator.





* On Sam I's without crystal oscillator, this trimmer is the frequency adjustment, and the 82.500 MHz oscillator and quadrupler trimmers are eliminated.

** This trimmer is used to adjust a 414.25 MHz trap. This trap keeps the 2nd L.O. signal from feeding back into the I.F. which could cause a spur to occur at 414.25 MHz. Only adjust this trimmer if the Sam indicates a signal at 414.25 MHz, when no signal is applied to the Sam RF in" on the front panel.

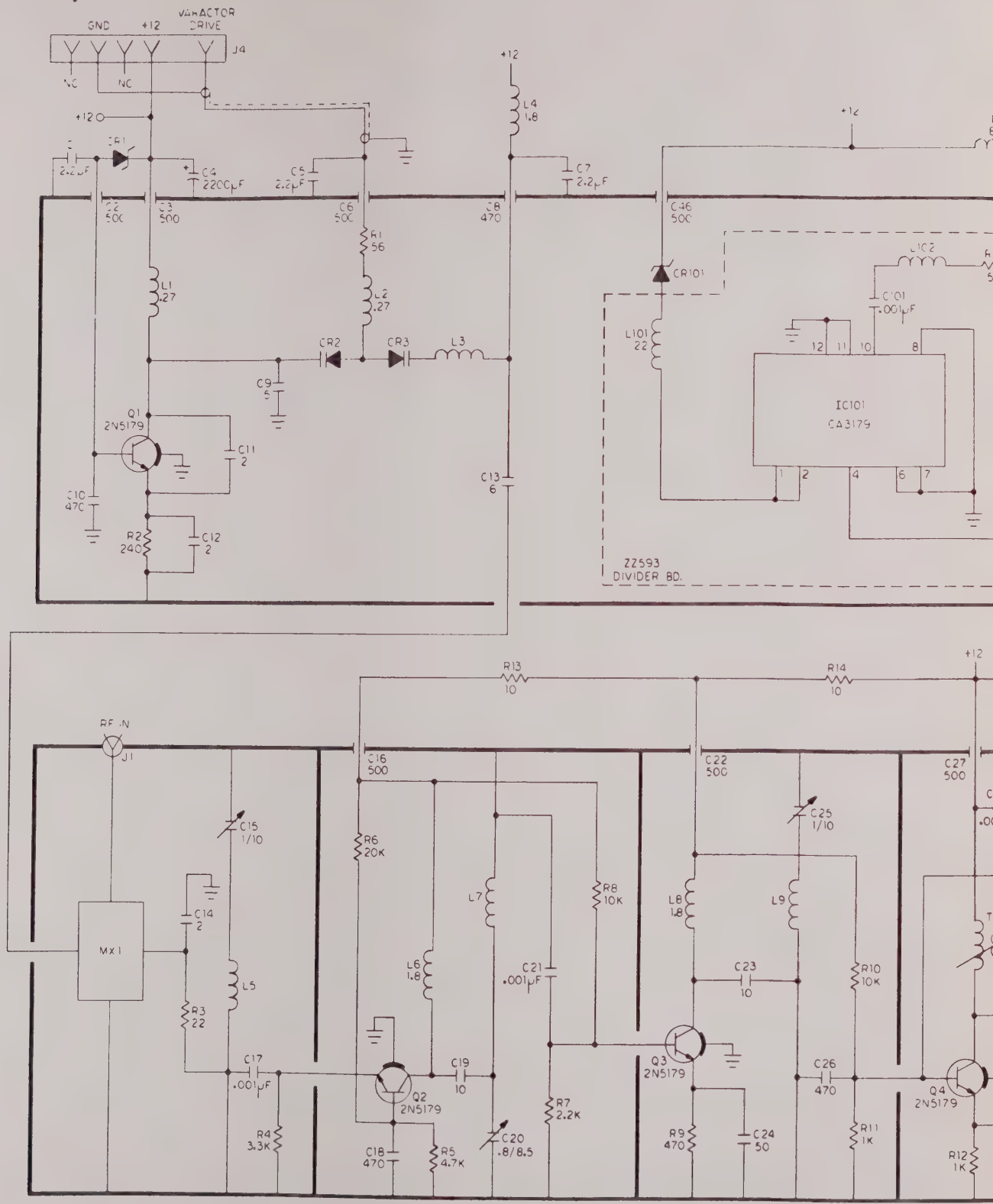
RF SPECIFICATIONS

TYPE	GAIN	SWEEP WIDTH
Jr. 300	+36 dB - +40 dB	-12 - 310 MHz
Jr. 400	+36 dB - +40 dB	-12 - 410 MHz
Jr. 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
Jr. 450	+36 dB - +40 dB	-12 - 460 MHz
I 300	+36 dB - +40 dB	-12 - 310 MHz
I 400	+36 dB - +40 dB	-12 - 410 MHz
I450	+36 dB - +40 dB	-12 - 460 MHz
I 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
I 450 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
II 300	+36 dB - +40 dB	-12 - 310 MHz
II 400	+36 dB - +40 dB	-12 - 410 MHz
II 450	+36 dB - +40 dB	-12 - 460 MHz
II 300	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
III 450	+36 dB - +40 dB	-12 - 460 MHz
III UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
IV 450	+36dB - +40 dB	-12 - 460 MHz
IV UHF	VHF +36dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz

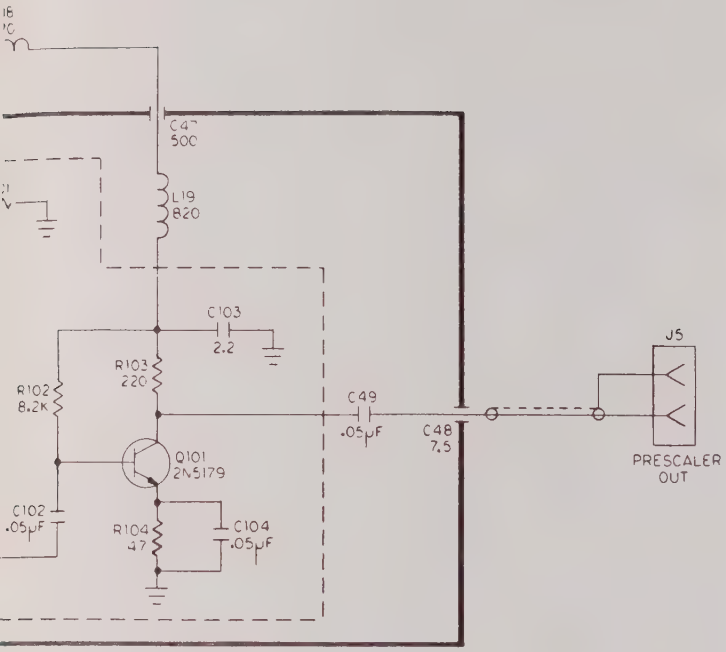
NOTE

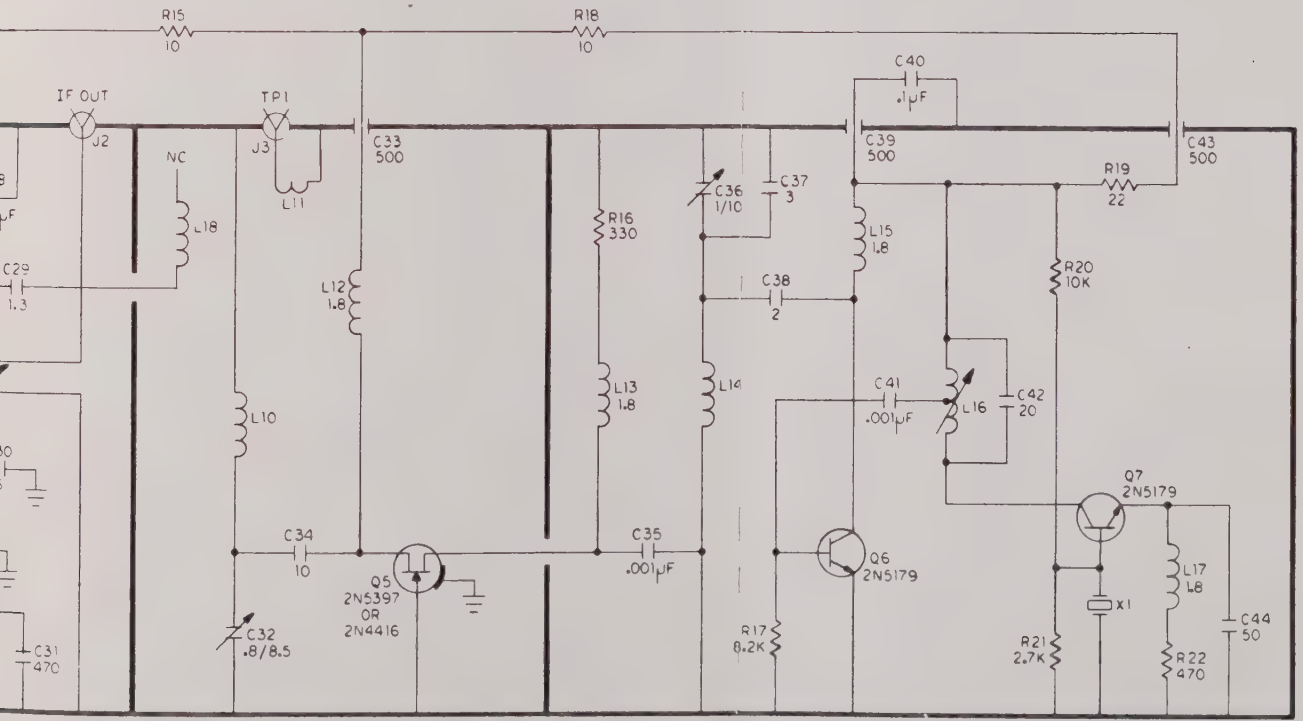
All of these RF specifications will include units with the analyzer option.

RF Assy Sch

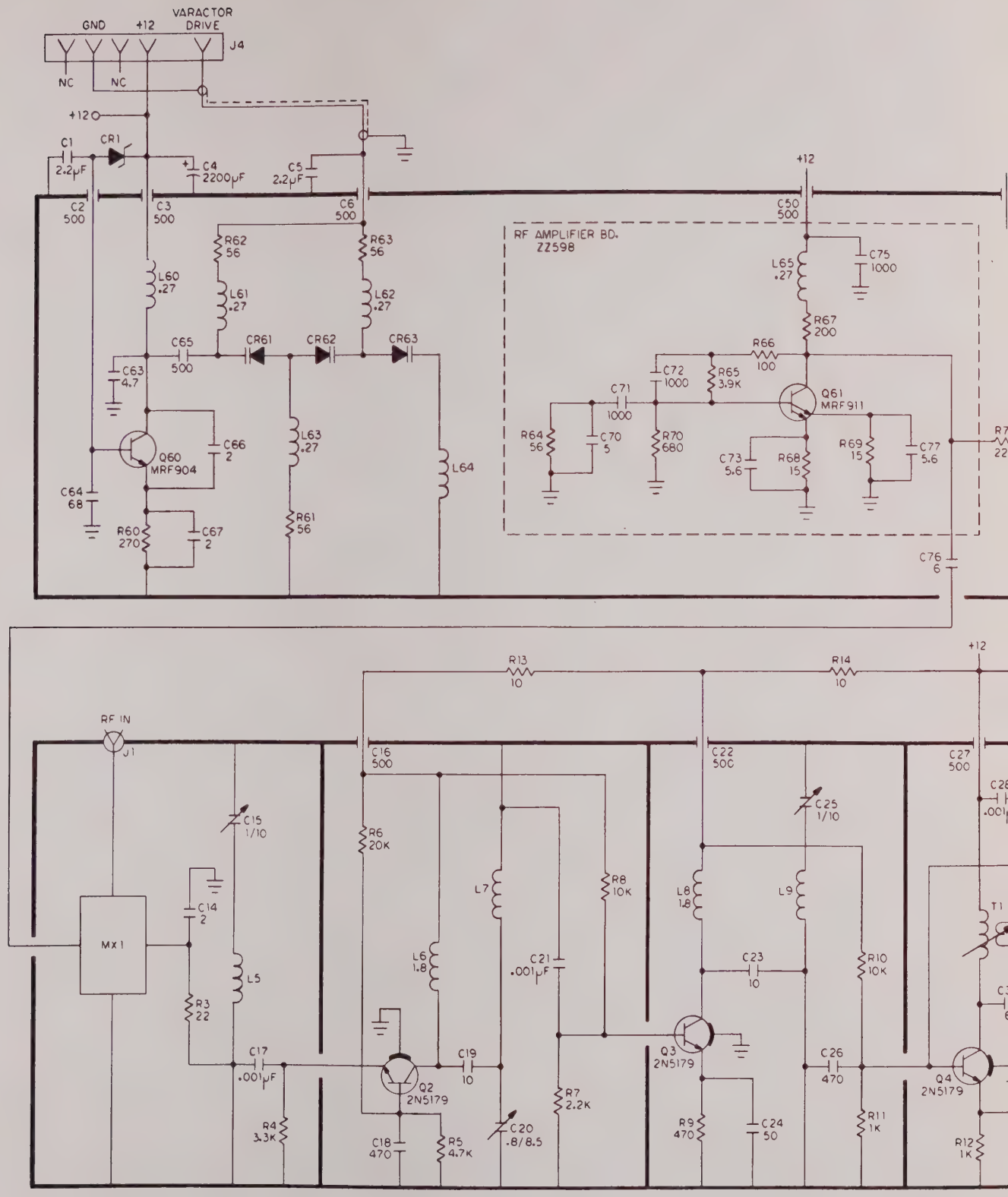

GND
+12
VARACTOR DRIVE
J4
NC
NC
+12
+12
L4 1.8
C7 2.2µF
C4 2200µF
C5 2.2µF
C2 500
C3 500
C6 500
C8 470
C46 500
R1 56
L1 .27
L2 .27
CR1
CR2
CR3
L3
C9 5
Q1 2N5179
C11 2
C10 470
R2 240
C12 2
C13 6
CR101
L101 22
IC101 CA3179
C101 .001µF
ZZ593 DIVIDER BD.
R13 10
R14 10
RF IN
J1
C16 500
C22 500
C27 500
C15 1/10
C25 1/10
R6 20K
L7
R8 10K
L8 1.8
L9
MX1
C14 2
L6 1.8
C21 .001µF
C23 10
R10 10K
L5
R3 22
C17 .001µF
C19 10
Q2 2N5179
Q3 2N5179
C26 470
Q4 2N5179
R7 2.2K
R4 3.3K
C18 470
R5 4.7K
C20 .8/8.5
R9 470
C24 50
R11 1K
R12 1K

SAM II
RF ASSY

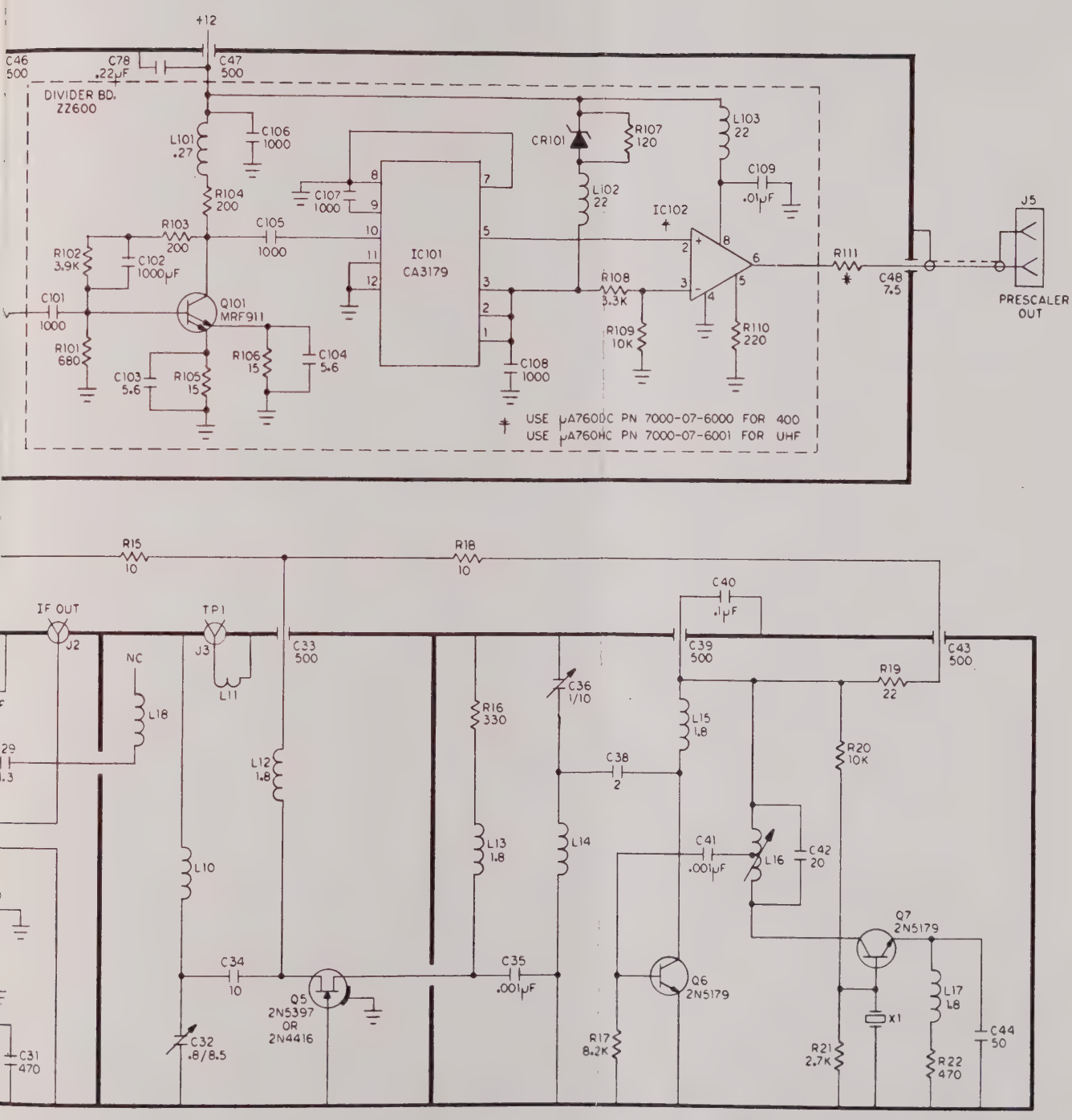




REVISIONS			WAVETEK
	ECN'S	BY	
A			SAM II RF Assy
B			
C			DRAWN BY: D. J. WATSON
D			DATE: 1-14-81
E			NUMBER: 0414-30-0003
			APP'D

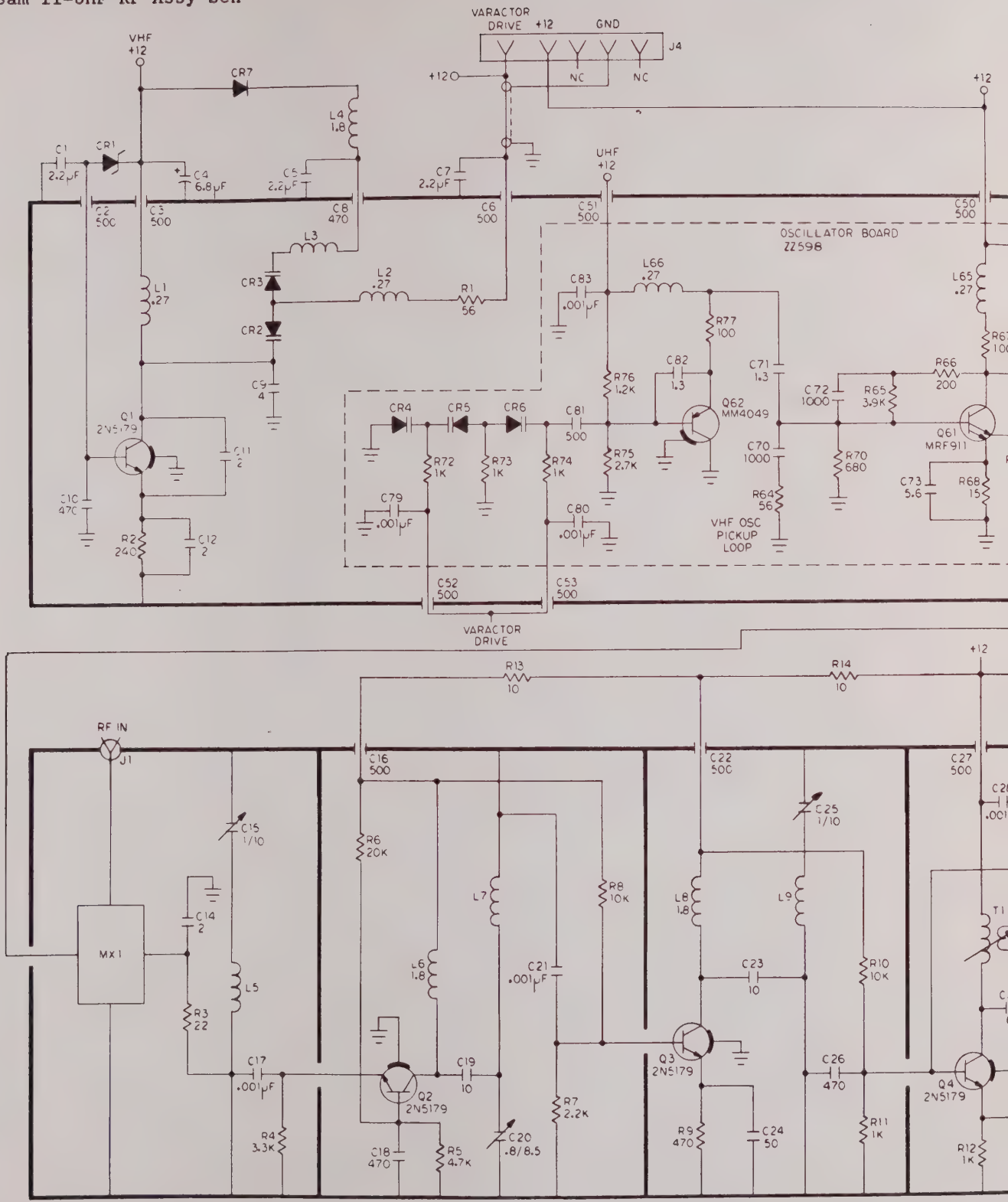

GND
+12
VARACTOR DRIVE
J4
NC
NC
+12
C1
2.2μF
CR1
C4
2200μF
C5
2.2μF
C2
500
C3
500
C6
500
R62
56
R63
56
L60
.27
L61
.27
L62
.27
C65
500
CR61
CR62
CR63
C63
4.7
Q60
MRF904
C66
2
L63
.27
L64
C64
68
R60
270
C67
2
R61
56
RF AMPLIFIER BD.
ZZ598
+12
C50
500
L65
.27
C75
1000
R67
200
R66
100
C72
1000
R65
3.9K
C71
1000
Q61
MRF911
R64
56
C70
5
R70
680
C73
5.6
R68
15
R69
15
C77
5.6
C76
6
R13
10
R14
10
+12
RF IN
J1
C16
500
C22
500
C27
500
C15
1/10
C25
1/10
R6
20K
L7
R8
10K
L8
1.8
L9
T1
C14
2
MX1
L5
L6
1.8
C21
.001μF
C23
10
R10
10K
R3
22
C17
.001μF
C19
10
Q2
2N5179
Q3
2N5179
C26
470
Q4
2N5179
R7
2.2K
R4
3.3K
C18
470
R5
4.7K
C20
.8/8.5
R9
470
C24
50
R11
1K
R12
1K

SAM II-400
RF ASSY

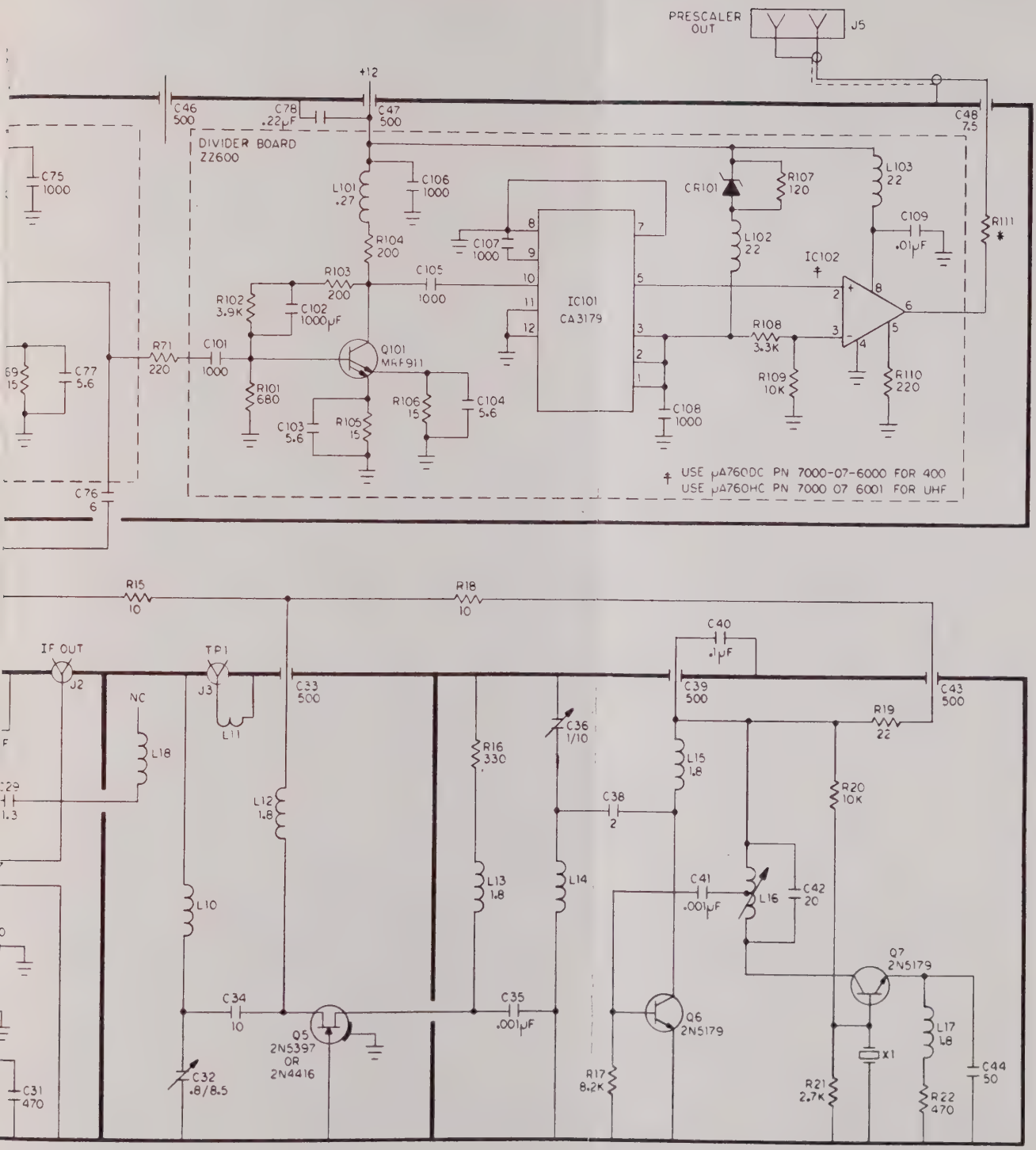


REVISIONS			WAVETEK
	ECN'S	BY	
A			SAM II 400 RF ASSY
B			
C			DRAWN BY: D.J. WATSON; DATE: 1-14-81; NUMBER: 0414-30-0004
D			APP'D
E			

Sam II-UHF RF Assy Sch

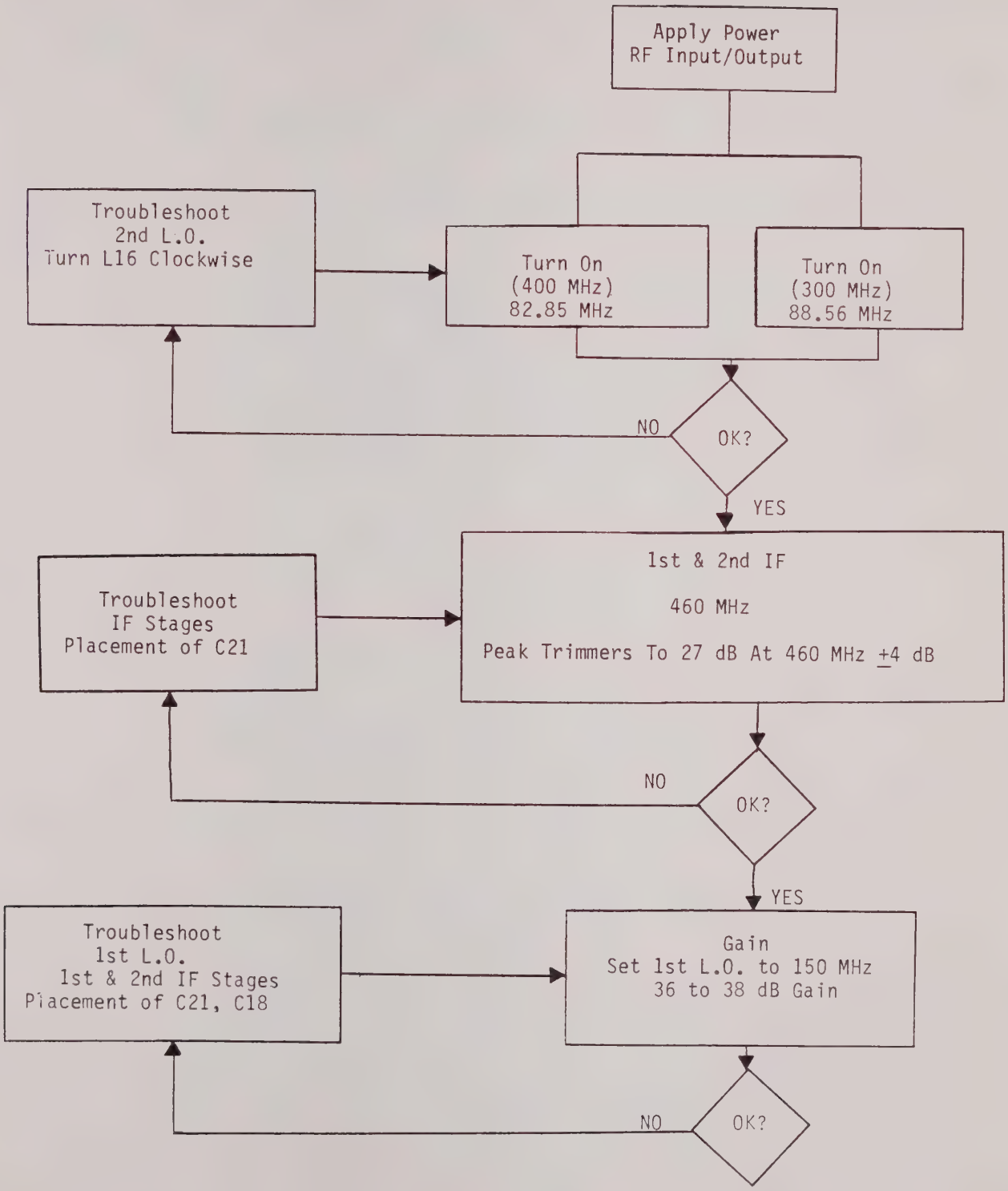


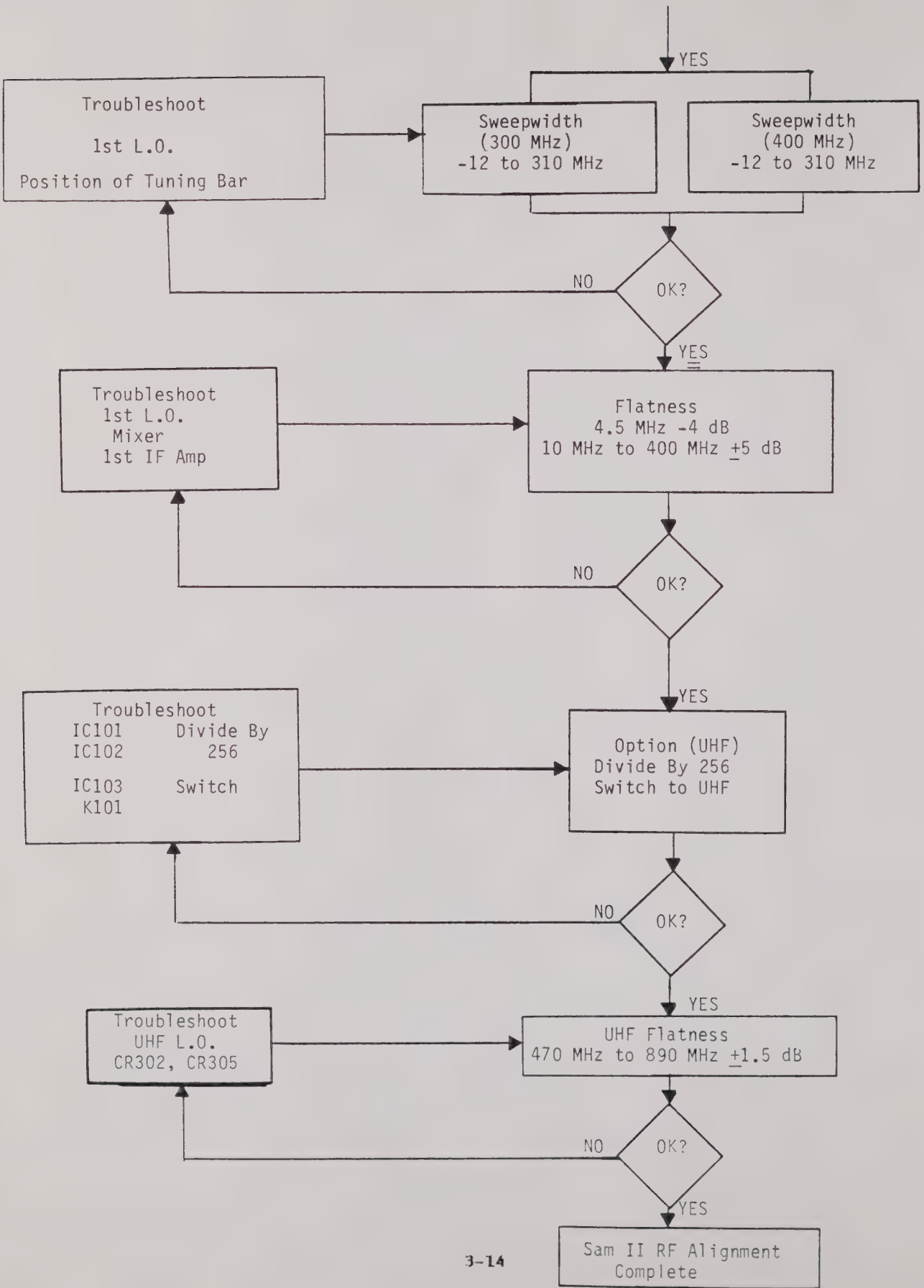
SAM II-UHF RF ASSY



REVISIONS			WAVETEK
	ECN'S	BY	
A			SAM II UHF RF Assy
B			
C			
D			DRAWN BY: D. J. WATSON; DATE: 1-14-81; NUMBER: 0914-30-0005
E			APP'D

Sam II RF Head Alignment (Generalized)




YES
Troubleshoot
1st L.O.
Position of Tuning Bar
Sweepwidth
(300 MHz)
-12 to 310 MHz
Sweepwidth
(400 MHz)
-12 to 310 MHz
NO
OK?
YES
Troubleshoot
1st L.O.
Mixer
1st IF Amp
Flatness
4.5 MHz -4 dB
10 MHz to 400 MHz ±5 dB
NO
OK?
YES
Troubleshoot
IC101 Divide By
IC102 256
IC103 Switch
K101
Option (UHF)
Divide By 256
Switch to UHF
NO
OK?
YES
Troubleshoot
UHF L.O.
CR302, CR305
UHF Flatness
470 MHz to 890 MHz ±1.5 dB
NO
OK?
YES
Sam II RF Alignment
Complete

RF TROUBLESHOOTING

Before taking voltage readings in the RF itself, be sure proper voltages are being supplied to the RF.

There is 12 V supplied to the oscillator board along with varactor drive 0 to 12 volts for tuning.

The first IF amp. transistor is a 5179 and should read approximately 1.6 volts on the emitter, 2.4 volts on the base, and 12 volts on the collector.

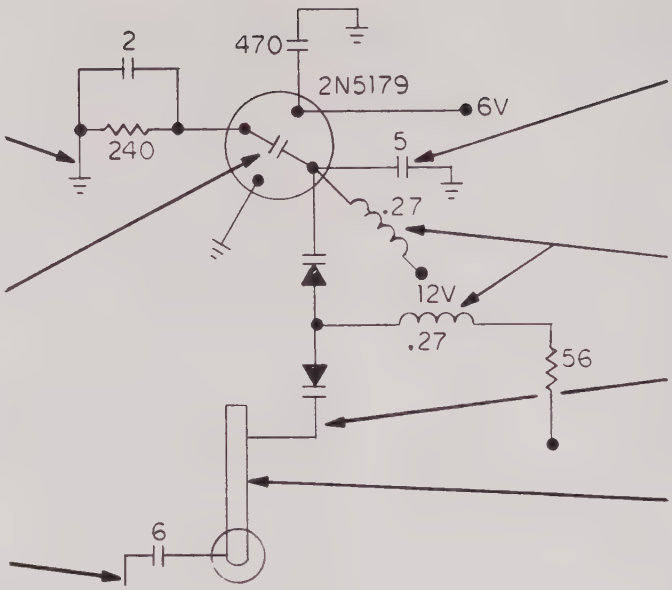
The second IF amp. transistor is also a 5179 which is coupled to the first amp. stage by its base and should read 2.2 colts, 1.3 volts for the emitter and 12 volts for the collector.

In the output mixer stage, a 5179 transistor is used. There should be 1.07 volts on the base which is connected to the 2nd amp. stage by a 470 pf. cap. The emitter should read .3 to .7 volts. The collector is supplied by 12 volts.

The second L.O. (not crystal controlled) uses a 4416 transistor. There should be 12 volts on the collector and 1.5 volts on the base.

If all voltages in the RF are correct, but it still does not meet gain, sweep, or flatness specs, the SAM should be returned to Wavetek for repair and calibration.

SAM 300 1st L.O.



3A. Move grounded end to help sweep.

2A. To increase sweep change to 2.2 pf. To lower sweep change to 1.3 or 1.5 mud cap.

7A. Raising and lowering 6 pf. will help gain at 4.5 MHz.

6A. Change the position of the sweep cap to increase sweep.

1A. Change .27 chokes to to 1.8 to help sweep.

4A. To raise top end range, cut off some varactor lead.

5A. Raise frequency by lowering inductor. Lower frequency by raising inductor.

SWEEP

1B Be sure the red cap (470pf) is soldered close to the transistor or the signal will drop off on the high end.

2B If signal drops off before 300 MHz, try replacing the feedback cap 2pf with 1.3 or 1.5 mud caps, if you have plenty of sweep.

3B Changing the position of the emitter cap and resistor will also change frequency range.

4B Be sure the varactor voltage is correct before changing the varactors.

5B For best results, the main tuning inductor should be parallel with the bottom.

6B. Changing the position of the sweep cap can help increase sweep and improve linearity.

NOTE

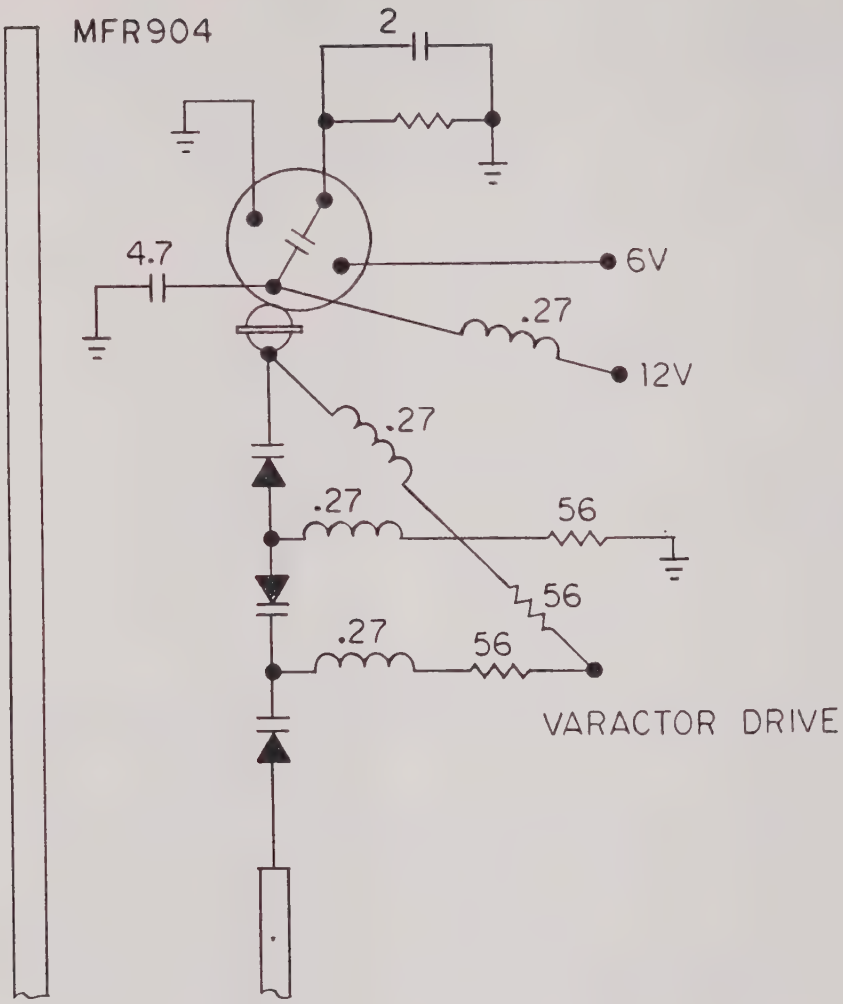
By leaving the L.O. as close to the original construction, it will help sweep width, flatness, and linearity. Remove any solder blobs and long lengths of leads.

FLATNESS

7B Adjust the 6pf for best low end flatness by moving it around for best results, also shortening the leads of the 6pf will help.

7C To help flatness at 4.5 MHz, resolder the tuning inductor higher up where it connects with the 6pf.

7D If flatness is still a problem at 4.5 MHz, remove the 2pf cap at the mixer input.



Low end flatness can be helped by changing the pick-off loop cap to a different value.

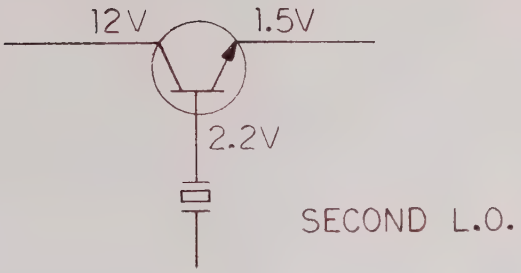
A 2pf on the mixer output will help flatness.

Signal drops off at 300mHz or above, try checking the chip cap for cold solder or not being grounded.

You can find a bad varactor by placing a good one in parallel with it and watch for signal on the scope.

If all else fails, change 1st L.O. transistor to help flatness on the high end.

If signal looks bad on the high end, a bad chip cap, may be the problem.

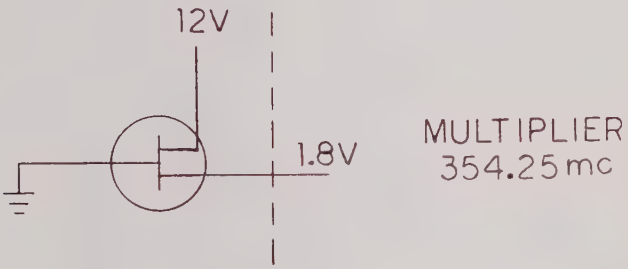


1. Set 88 MHz second L.O. with Spectrum Analyzer by tuning the oscillator variable inductor for maximum signal.

2. Set 354.25 mc by adjusting both trimmer capacitors for maximum.

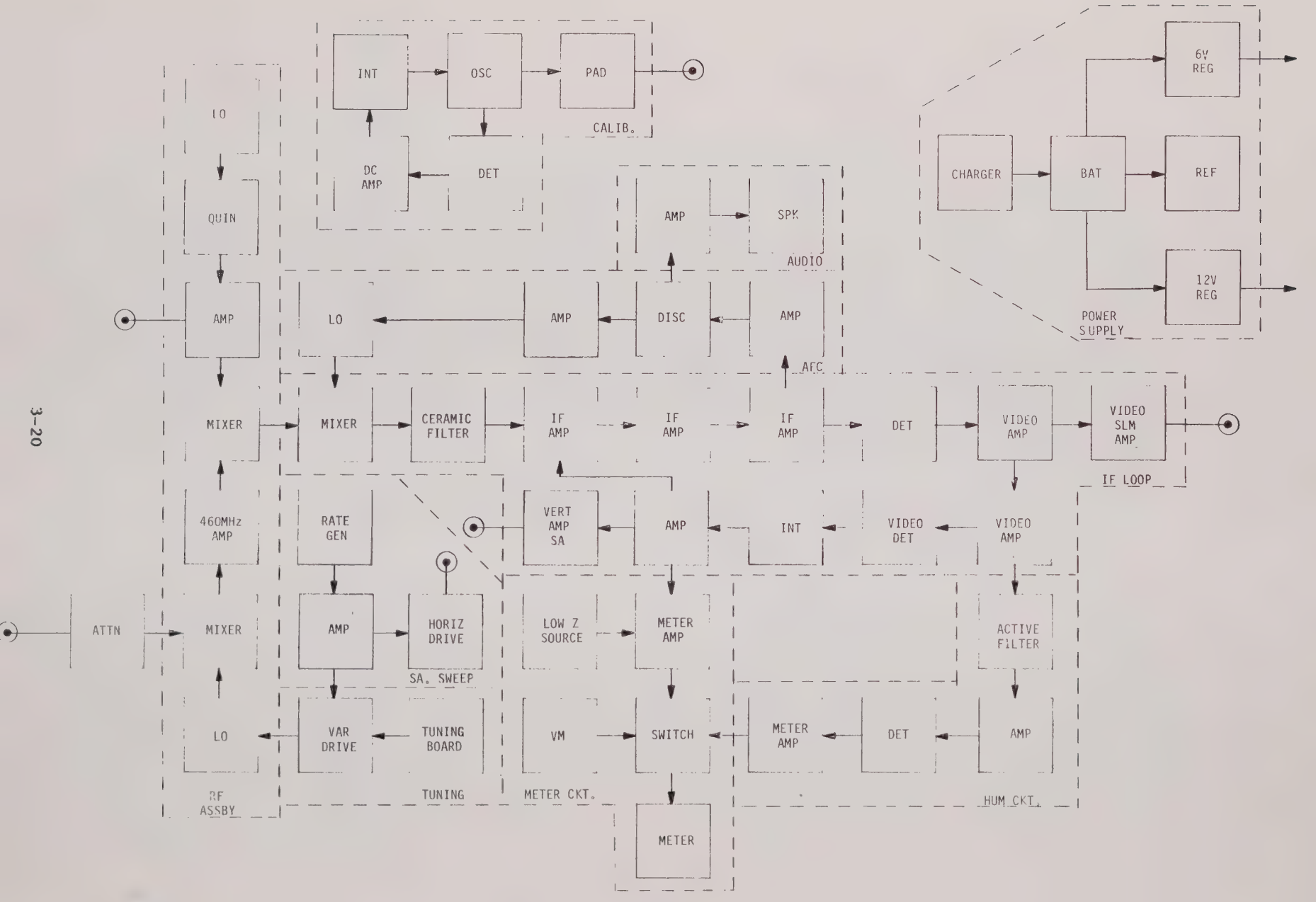
3. Set and adjust I.F. to 400 mc.

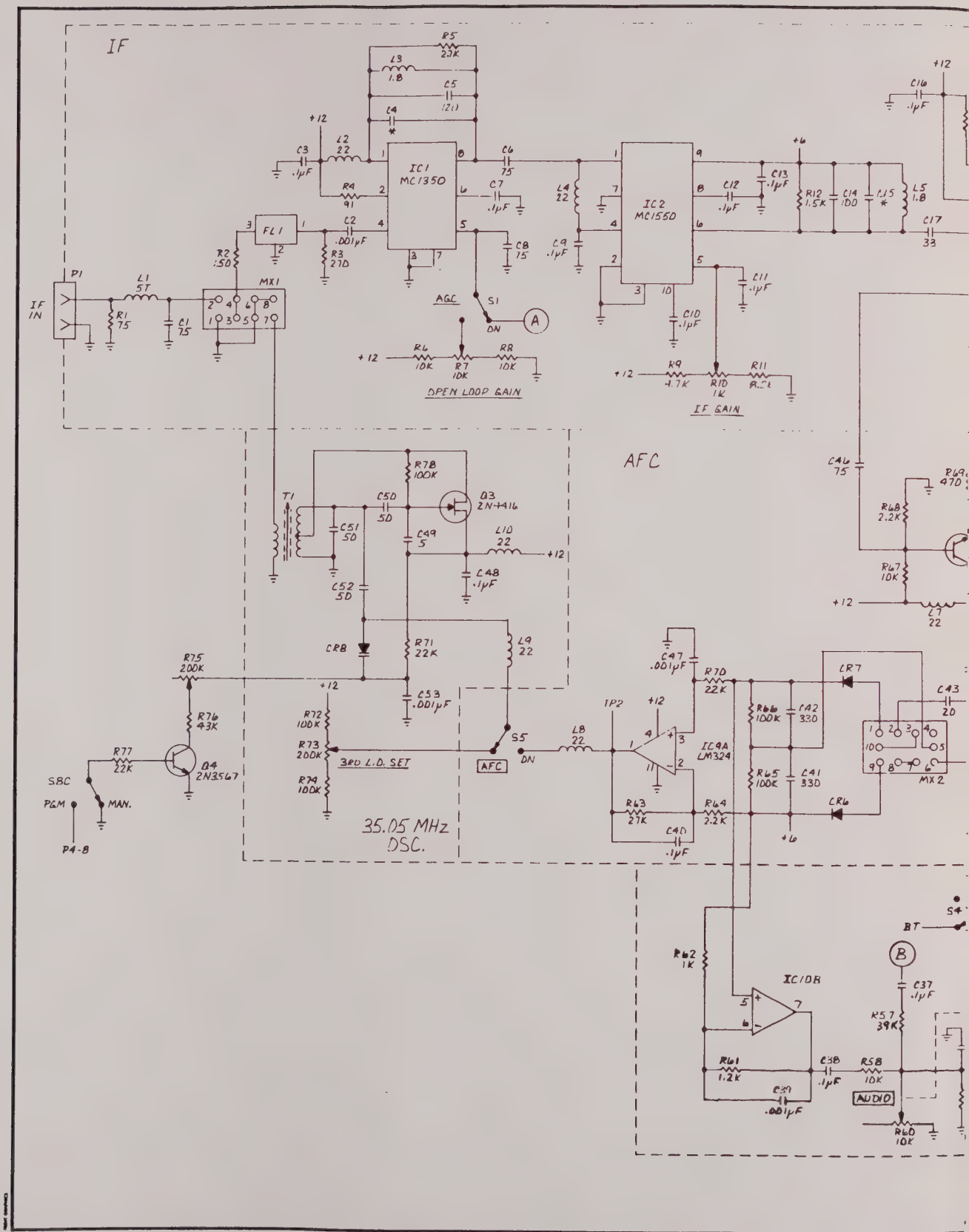
4. Check sweep and flatness

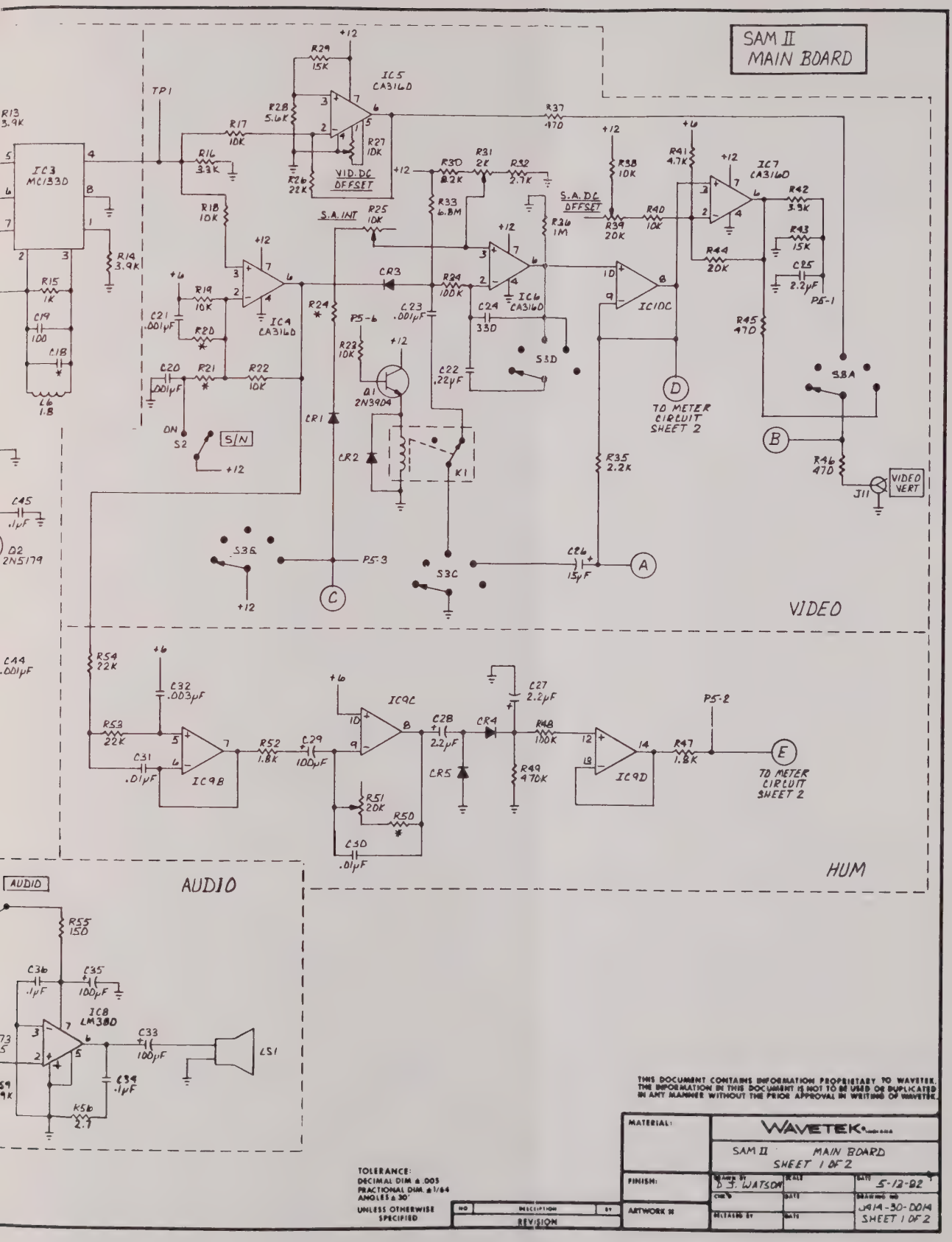


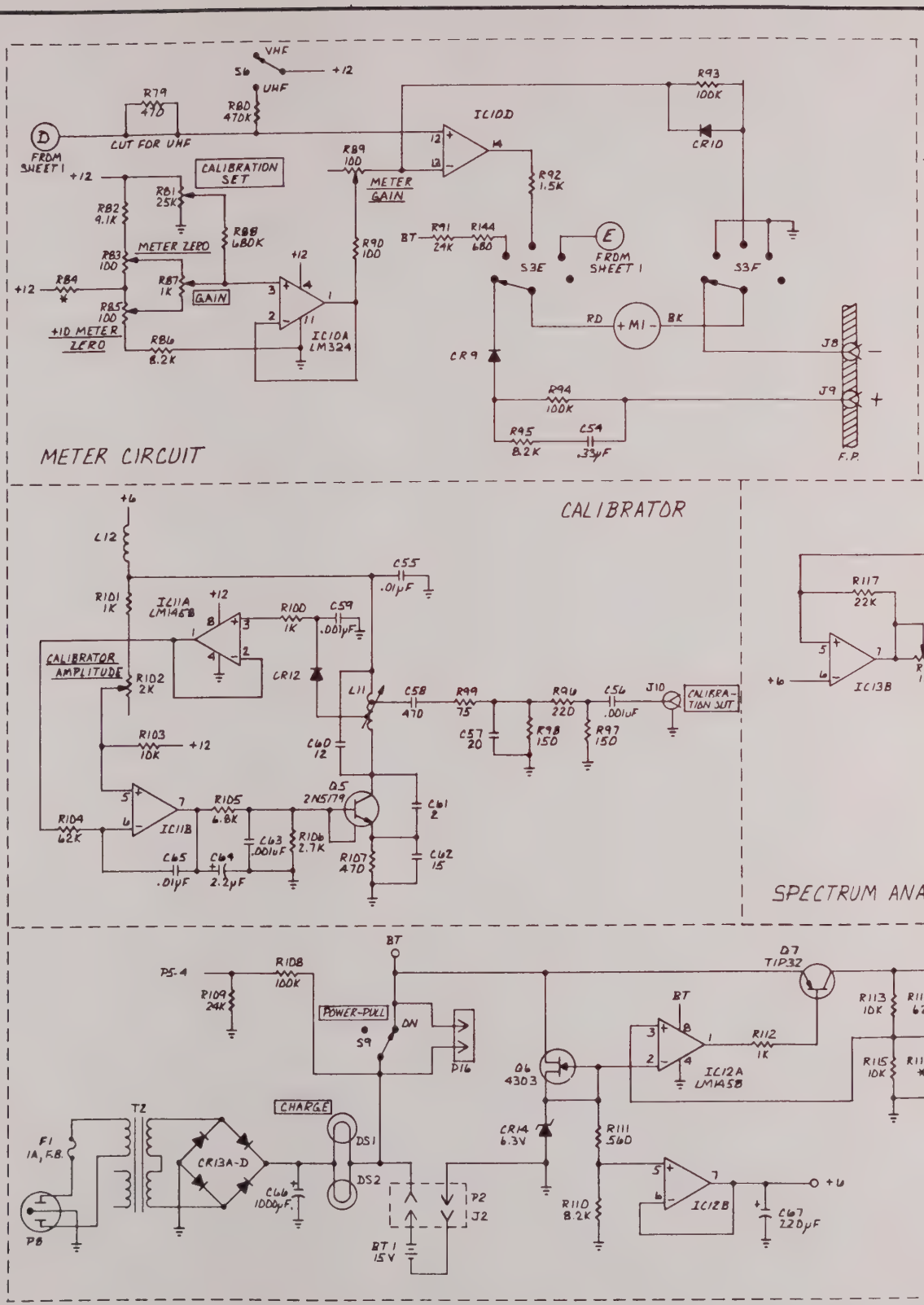
NOTE:

IF YOU CAN NOT FIND A 354.25 SIGNAL OUT OF THE QUAD AMP.,TRY ADJUSTING SECOND I.F. CAPACITOR (trimmer) TO SEE IF IT IS LOADING THE 354.25 SIGNAL TOO MUCH AND DRIVING IT OFF FREQUENCY.

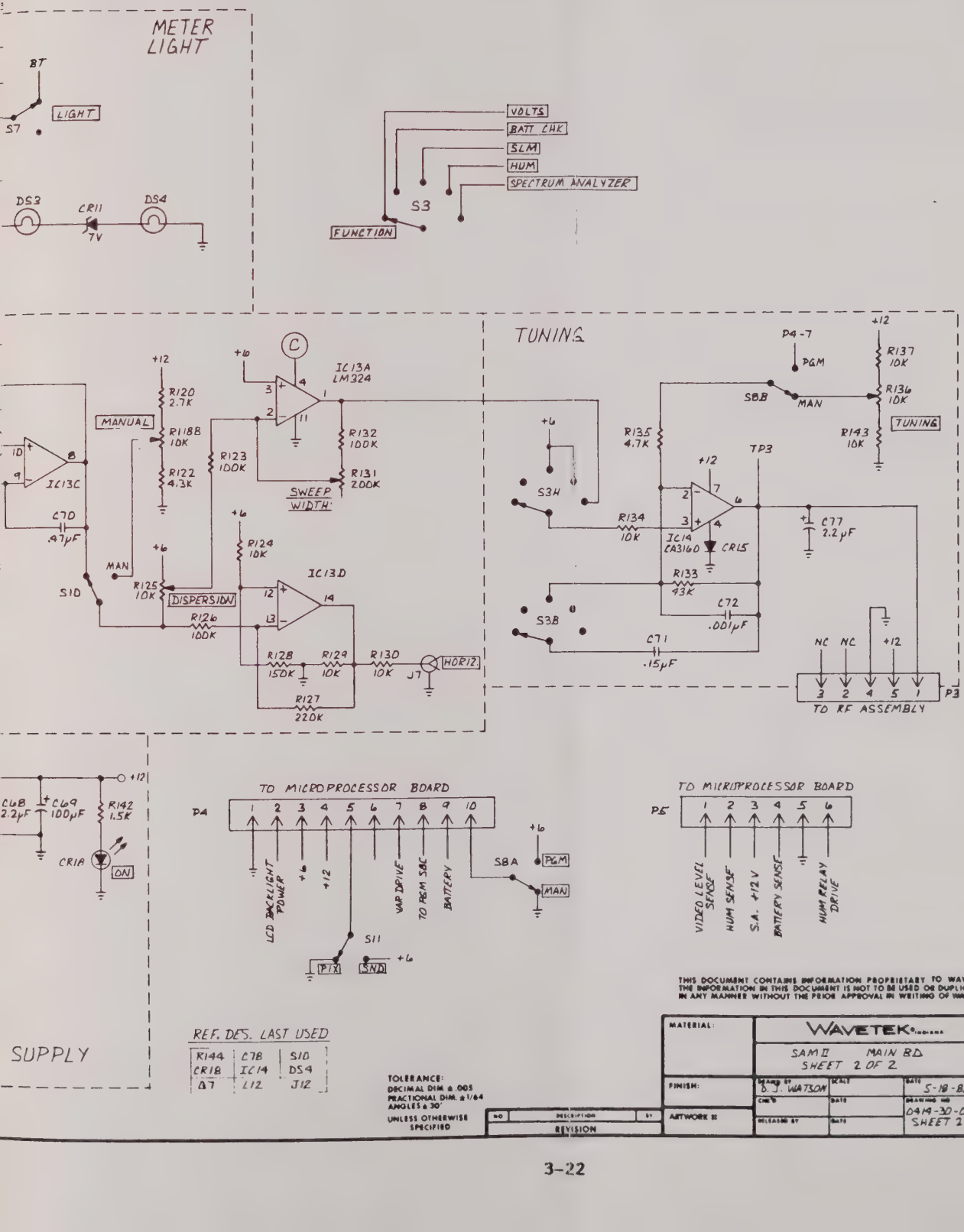

INT
OSC
PAD
CALIB.
DC AMP
DET
LO
QUIN
AMP
SPK
AUDIO
LO
AMP
DISC
AMP
AFC
6V REG
CHARGER
BAT
REF
12V REG
POWER SUPPLY
MIXER
MIXER
CERAMIC FILTER
IF AMP
IF AMP
IF AMP
DET
VIDEO AMP
VIDEO SLM AMP
IF LOOP
460MHz AMP
RATE GEN
VERT AMP SA
AMP
INT
VIDEO DET
VIDEO AMP
ATTN
MIXER
AMP
HORIZ DRIVE
LOW Z SOURCE
METER AMP
ACTIVE FILTER
SA. SWEEP
LO
VAR DRIVE
TUNING BOARD
VM
SWITCH
METER AMP
DET
AMP
RF ASSBY
TUNING
METER CKT.
HUM CKT.
METER


IF
IF IN
P1
L1 5T
R1 75
C1 75
MX1
FL1
R2 150
C2 .001μF
R3 270
C3 .1μF
L2 22
R4 91
R5 22K
L3 1.8
C5 12(1
C4 *
IC1 MC1350
C6 75
C7 .1μF
C8 75
C9 .1μF
L4 22
IC2 MC1550
C10 .1μF
C11 .1μF
C12 .1μF
C13 .1μF
R12 1.5K
C14 100
C15 *
L5 1.8
C16 .1μF
C17 33
+12
+6
AGC
S1
ON
A
R6 10K
R7 10K
R8 10K
OPEN LOOP GAIN
R9 4.7K
R10 1K
R11
IF GAIN
AFC
T1
R78 100K
C50 50
C51 50
C49 5
Q3 2N-1416
L10 22
C48 .1μF
C52 50
CR8
R71 22K
L9 22
C53 .001μF
R75 200K
R76 43K
R77 22K
Q4 2N3567
S.B.C
PGM
MAN.
P4-8
R72 100K
R73 200K
R74 100K
3RD L.O. SET
35.05 MHz OSC.
AFC
S5
DN
L8 22
TP2
C47 .001μF
R70 22K
IC9A LM324
R63 27K
R64 2.2K
C40 .1μF
R66 100K
C42 330
R65 100K
C41 330
CR7
CR6
C43 20
MX2
C46 75
R69 470
R68 2.2K
R67 10K
L7 22
S4
BT
B
R62 1K
IC10B
C37 .1μF
R57 39K
R61 1.2K
C38 .1μF
C39 .001μF
R58 10K
AUDIO
R60 10K


SAM II
MAIN BOARD
VIDEO
HUM
AUDIO
IC3 MC1330
IC4 CA3160
IC5 CA3160
IC6 CA3160
IC7 CA3160
IC10C
IC10D
IC9B
IC9C
IC9D
IC8 LM380
VID. DC OFFSET
S.A. DC OFFSET
S.A. INT
TO METER CIRCUIT SHEET 2
VIDEO VERT
S/N
TO METER CIRCUIT SHEET 2
THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO WAVETEK. THE INFORMATION IN THIS DOCUMENT IS NOT TO BE USED OR DUPLICATED IN ANY MANNER WITHOUT THE PRIOR APPROVAL IN WRITING OF WAVETEK.
WAVETEK
SAM II MAIN BOARD SHEET 1 OF 2
D. J. WATSON
5-12-82
J414-30-00M SHEET 1 OF 2
TOLERANCE: DECIMAL DIM. ± .005 FRACTIONAL DIM. ± 1/64 ANGLES ± 30°
UNLESS OTHERWISE SPECIFIED
REVISION


METER CIRCUIT
CALIBRATOR
SPECTRUM ANALYZER
POWER
S6
VHF
UHF
+12
R79
470
R80
470K
CUT FOR UHF
FROM SHEET 1
CALIBRATION SET
R81
25K
R82
9.1K
R83
100
METER ZERO
R88
680K
R84
R85
100
+10 METER ZERO
R87
1K
GAIN
R86
8.2K
IC10A
LM324
R90
100
METER GAIN
IC10D
R89
100
R93
100K
CR10
R92
1.5K
R91
24K
R144
680
BT
S3E
S3F
FROM SHEET 1
RD
+M1-
BK
CR9
J8
J9
F.P.
R94
100K
R95
8.2K
C54
.33μF
L12
R101
1K
IC11A
LM1458
C55
.01μF
R100
1K
C59
.001μF
CALIBRATOR AMPLITUDE
R102
2K
CR12
L11
C58
470
R99
75
C57
20
R98
150
R96
220
R97
150
C56
.001μF
J10
CALIBRATION SET
R103
10K
C60
12
Q5
2N5179
C61
2
C62
15
R104
62K
IC11B
R105
6.8K
C63
.001μF
R106
2.7K
R107
470
C65
.01μF
C64
2.2μF
R132
8.2K
R117
22K
SWEEP RATE
R118A
1M
R119
82K
IC13B
P5-4
R108
100K
R109
24K
POWER-PULL
S9
DN
P16
BT
D7
TIP32
Q6
4303
IC12A
LM458
R112
1K
R113
10K
R114
62K
R115
10K
R116
*
CHARGE
T2
F1
1A, F.B.
P8
CR13A-D
DS1
DS2
C66
1000μF
P2
J2
BT1
15V
CR14
6.3V
R111
560
R110
8.2K
IC12B
C67
220μF
+6

SAM II
MAIN BOARD



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REF. DES. LAST USED

R144	C78	S10
CR18	IC14	DS9
Δ7	L12	J12

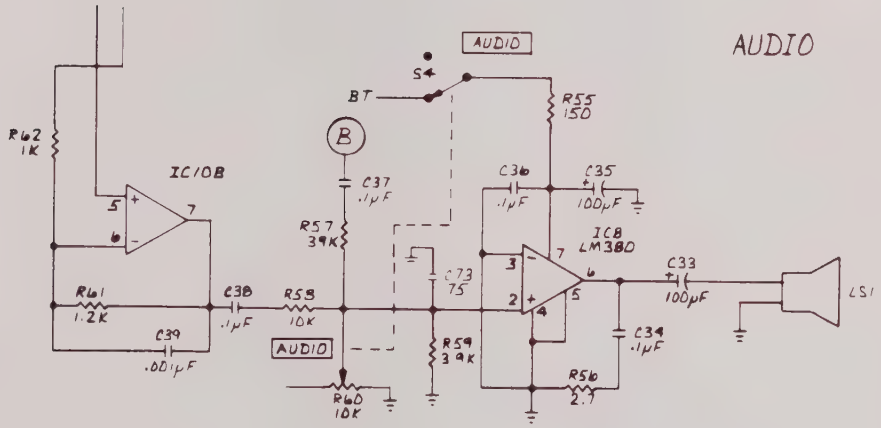
TOLERANCE:
DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED

NO	DESCRIPTION	BY
	REVISION	

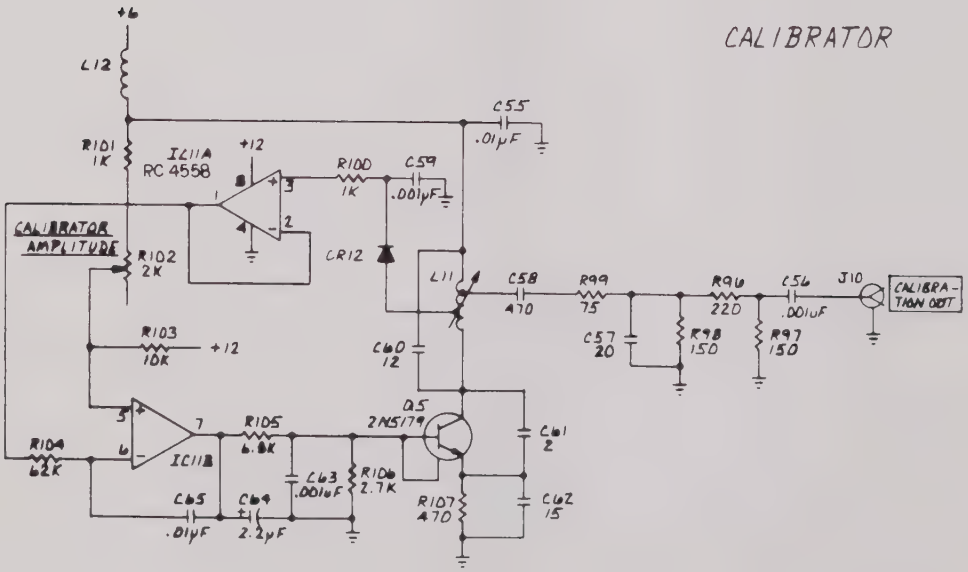
MATERIAL:	WAVETEK INDIANA
	SAM II MAIN BD. SHEET 2 OF 2
FINISH:	DRAWN BY D. J. WATSON — SCALE — DATE 5-18-82
	CHK'D — DATE — DRAWING NO 0419-30-0019 SHEET 2 OF 2
ARTWORK #	RELEASED BY — DATE

AUDIO

The demodulated signal at the output of IC5 is coupled by C37 to volume control R60. The discriminator output is amplified by IC10B and coupled to the wiper of R60. This allows for a clear reception of the FM signal. The wiper of R60 is connected to pin 2 of IC8. The IC8 has an internal gain of approximately 200. This signal is then coupled through C33 to the speaker. The purpose of C34 and R56 is to prevent high frequency (100kHz) oscillations.

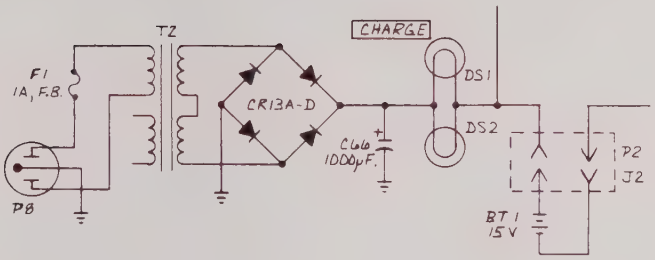


Q5 is configured as a common base oscillator. The feedback is accomplished through C61. C60 and L11 form the frequency determining tank circuit. CR12 and C59 detect a sample of the output. This detected voltage is then buffered by IC11A and applied to a comparator IC11B. R101, R102, and R103 provide a reference voltage that is also applied to a comparator IC11B. If the output level of the oscillator decreases, the detected voltage decreases causing the voltage on the inverting port of the comparator to decrease. This decrease in voltage causes the output of the comparator to increase. Since this voltage supplies the base bias, the transistor is driven harder, thus causing the amplitude of the oscillator to increase. This action provides a very stable closed loop leveling of the oscillator amplitude. C58 couples the output of the oscillator to a 75 ohm attenuator pad. The output at +20 dBmV is connected to the front panel F connector.



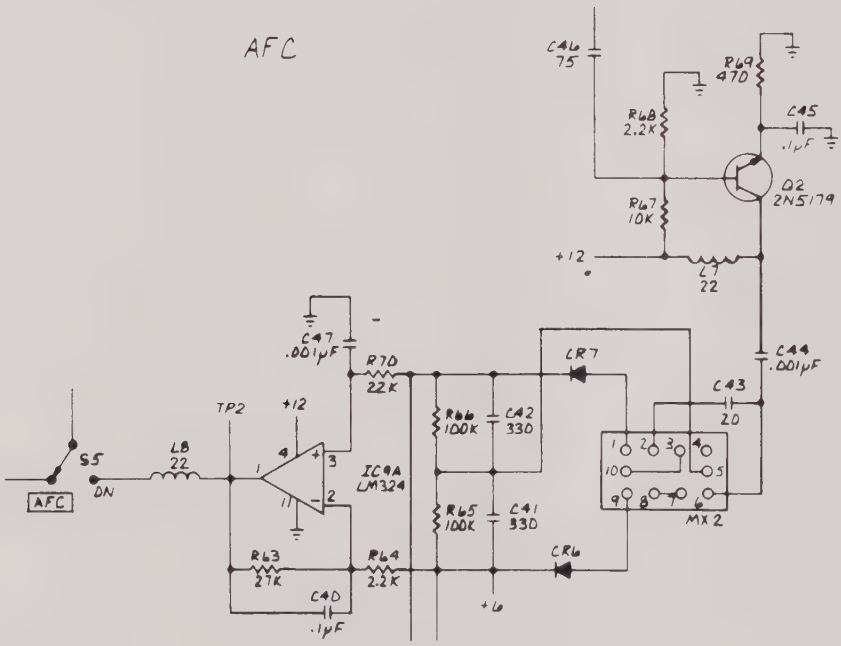
CHARGE CIRCUIT

The 110 VAC is applied through the front panel receptacle to transformer T2. T2 steps the voltage down to approximately 16 VAC. This voltage is then rectified by a full-wave bridge rectifier, CR-13. This voltage is filtered by C66 and applied to the battery by way of DS1 and DS2, which acts as a current limiter.



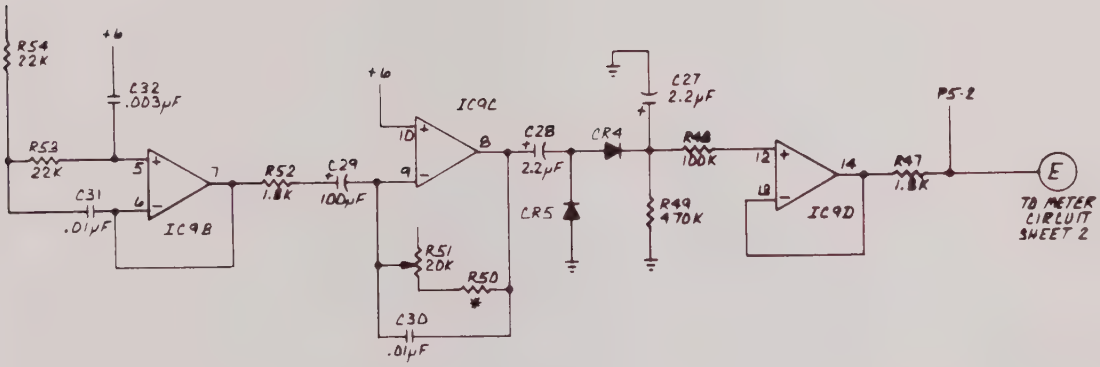
DISCRIMINATOR

The second output-pin of IC3 is a buffered output of the 10.7 MHz signal which is further amplified by Q2, which functions as a limiter. This amplified signal is then applied to the discriminator transformer (MX-2). The discriminator output as seen on pin 3 of IC9A will increase or decrease in voltage as the IF signal increases or decreases in frequency. This voltage is amplified by IC9A and the output pin 1, is applied to a varactor diode (BB105) in the 3rd L.O. (35.05 MHz). When the AFC switch is on, this voltage at the varactor will change. This changing voltage results in the 3rd L.O. increasing or decreasing in frequency, thus causing the mixed output to result in 10.7 MHz.



HUM

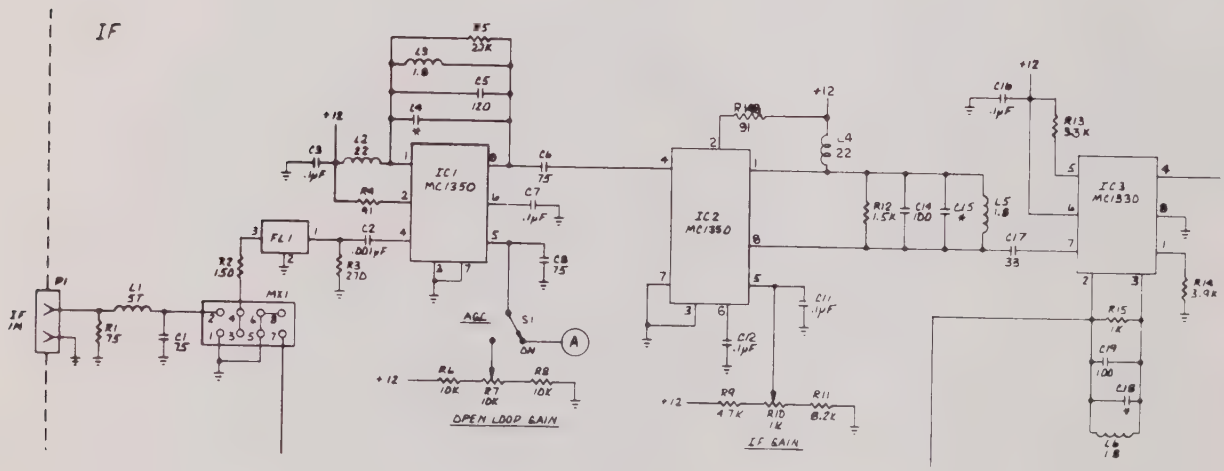
The hum circuit is designed to measure low frequency modulation. The peak detector circuit is disabled in the hum mode. It is disabled because you are not interested in reading a peak signal, but the amount of low frequency modulation onto the carrier. The output of the video amplifier (IC4 pin 6) is applied to an active filter consisting of IC9B. This active filter is designed to pass frequencies up to 500 Hz. This 500 Hz is to allow for an accurate measurement, if the hum is a square wave. Square waves contain frequencies much higher than the fundamentals. The 60 Hz signal if present is AC coupled to IC9C, which amplifies the signal. This signal from IC9C provides a 6V reference. The AC signal is applied to a voltage doubler (P-P detector), consisting of CR4, CR5, C27 and C28. The DC voltage is buffered by IC9D and applied to the meter movement through R47.



HUM

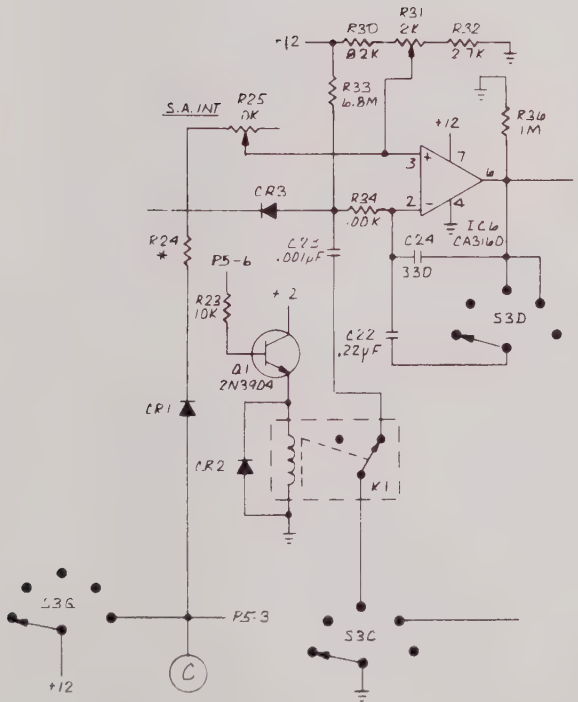
I.F.

The IF signal is applied at P1. The R1 is a 75 ohm termination. L1 and C1 provide for a low pass filter. The signal is then mixed with a 35.05 MHz signal in MX-1. The resultant output of 10.7 MHz is applied to a ceramic filter FL-1, which limits the bandwidth to approximately 280 kHz. The signal is then amplified by IC1 (1350), which is capable of 50 dB of gain. The IC1 has an AGC range of 60 dB. This circuit has to be tuned to 10.7 MHz in order to achieve the high gain. This tuning is accomplished by C4, C5 and L3. The R5 provides decueing to allow for correct bandwidth. This amplified signal is capacitively coupled to IC2, which provides an additional 20 dB of gain. This gain can be varied by R10. This may need to be changed to provide optimum meter tracking. This circuit also needs to be tuned to 10.7 MHz by C14, C15 an L5. The R12 provide decueing to allow for correct bandwidth. This amplified signal is applied to IC3, which provides additional gain and incorporates the video detector. This circuit is tuned to 10.7 MHz by C18, C19 and L6. The R15 provides decueing to allow for correct bandwidth. At TP-1 there isn't any RF present, however there is some modulation.



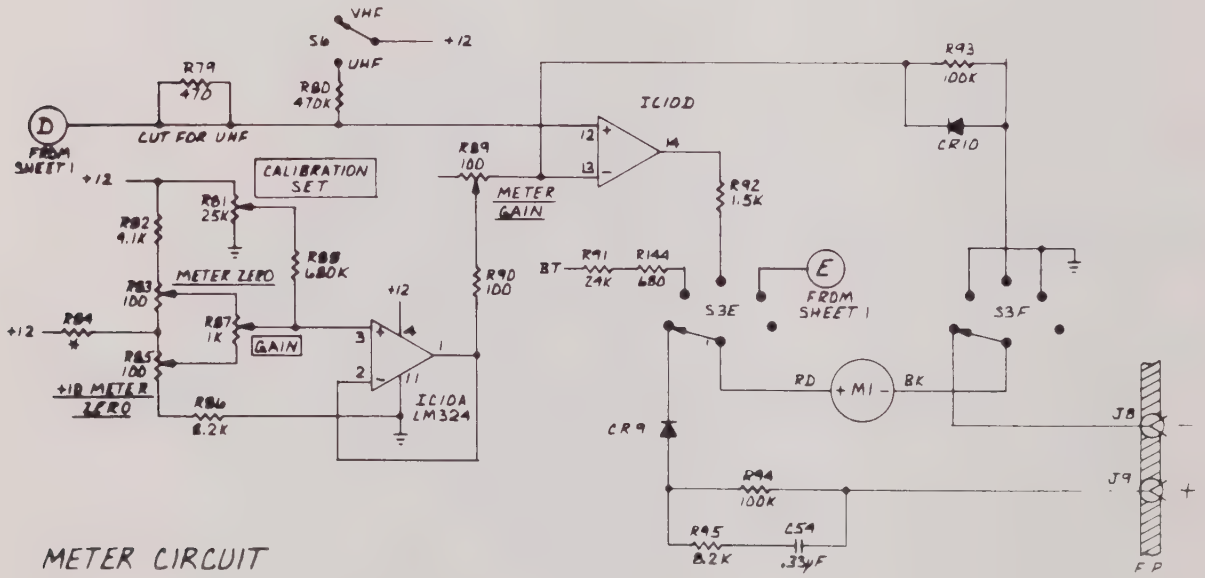
INTEGRATOR

The integrator is a comparator used to supply the AGC voltage. A reference voltage is set up on pin 3 of IC6, which is controlled by R31. When a strong IF signal is applied to the IF input, the voltage on pin 2 decreases. As this voltage decreases, the voltage on pin 6 increases. This signal is buffered by IC10C. The output at pin 8 is applied to pin 5 of IC1. This feedback will decrease the gain of the 1350. This AGC loop maintains a constant signal level through the IF. The purpose of C22 and C24 is to slow the comparator to prevent oscillations. When in the spectrum analyzer mode, 12V is applied to CR1 through R24 and R25. This changes the integrator reference voltage a very small amount. This integrator voltage changes the gain of the IF (since the integrator supplies the AGC voltage). The R25 adjusts this level for the best spectrum analyzer display.



METER CIRCUIT

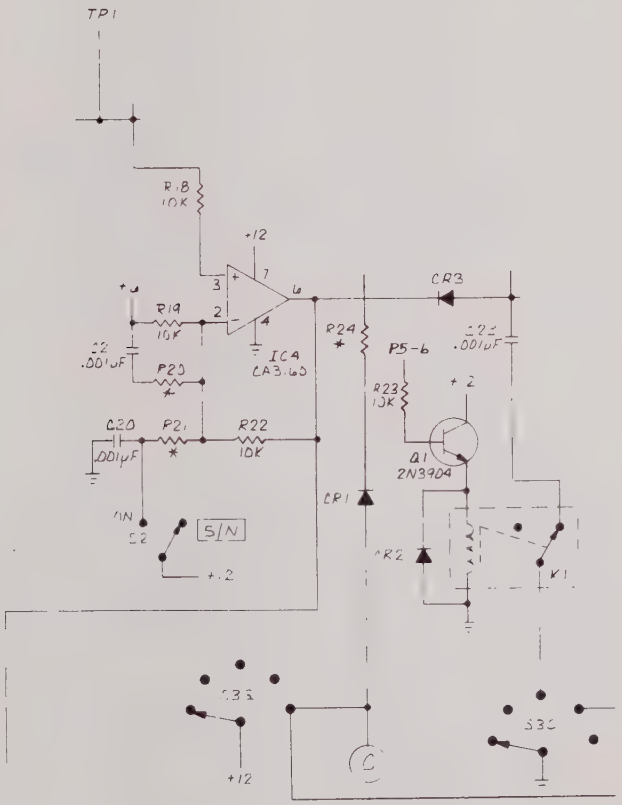
The meter circuit is driven by the AGC voltage rather than the detected IF. The purpose of IC10A is to provide a reference voltage to be compared with the AGC voltage. The main reference is set up by R82, R83, R84, and R85. The R81 will provide a small amount of deviation to this main reference voltage. The R87 is used to increase this reference voltage a very small amount, to boost the meter reading by 10 dB for reading the low signal levels. IC10A is merely a buffer to provide isolation between the voltage divider and the meter amplifier. IC10D is a voltage to current converter. As the voltage increases on pin 10 above the voltage on pin 13, the voltage on pin 14 also increases. This voltage at pin 14 will cause current to flow through the meter and through CR10. The CR10 is forward biased and therefore allows the current to flow back through R92 to IC10D. Since the amount of gain is determined by the feedback resistance divided by the input resistance, the gain can be varied by the input resistance of R89. The R89 is used to calibrate the high end of the meter.



METER CIRCUIT

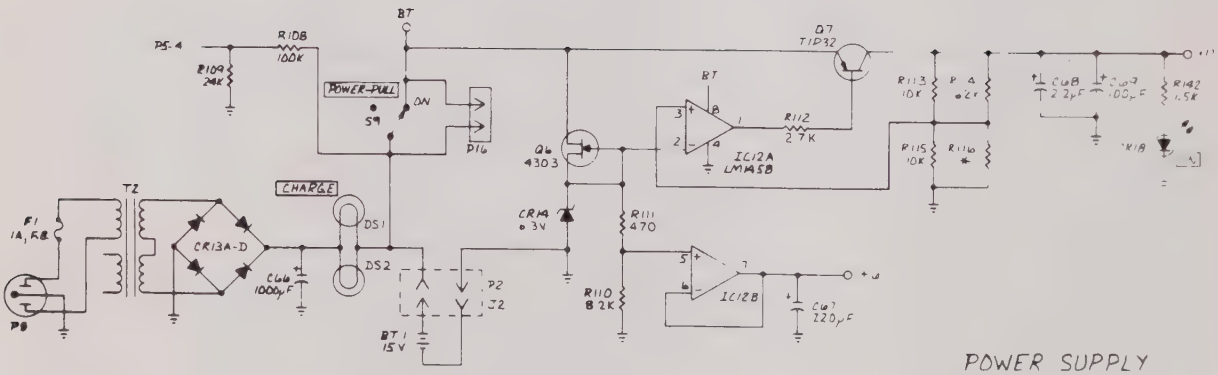
PEAK DETECTOR

The detected output from the IF is amplified by IC4 and is fed to a peak detector of CR3 and C23. The purpose of this detector circuit is to charge up C23 to the peak value of the modulation. All signal level meters measure peak value not average or RMS values. No detector is perfect and since C23 will discharge a certain amount, this voltage will still not be an absolute peak value. The purpose of C21 and R20 is to boost the gain of IC4 a small amount when video modulation is present. The C23 provides a ground path for the peak detector circuit.



POWER SUPPLY

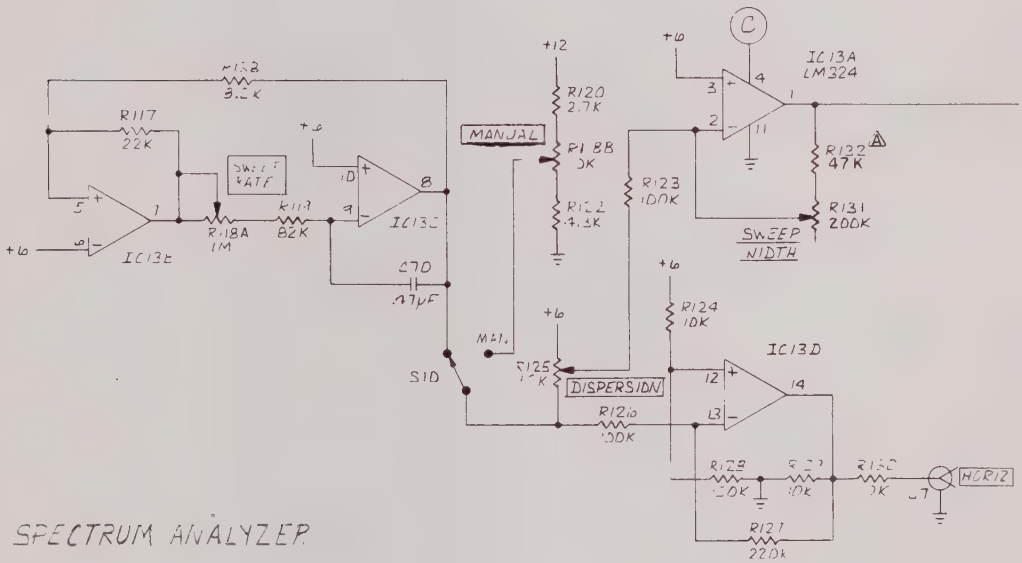
Q6 supplies a constant current source for zener diode CR14. The CR14 provides a 6.2 V reference, which goes to a voltage divider of R110 and R111. This 6.2V reference is buffered by IC12B. The 6.2 V reference is applied to the inverting port of comparator IC12A. When power is first applied, the output on pin 1 of IC12A will be high, which causes Q7 to conduct very slightly. This allows only a small voltage to be seen on the output of the supply. The supply voltage is applied to a voltage divider of R113, R114, R115 and R116. The voltage divider cuts voltage approximately in half. This voltage is applied to the non-inverting port of IC12A. Since this voltage is lower than the voltage on pin2, the output on pin 1 will decrease, Q7 conducts harder, which supplies a higher supply voltage. The supply voltage is regulated by comparing the values of the two input voltages of IC12A. R116 is chosen to result in a 12V reference.



POWER SUPPLY

SPECTRUM ANALYZER

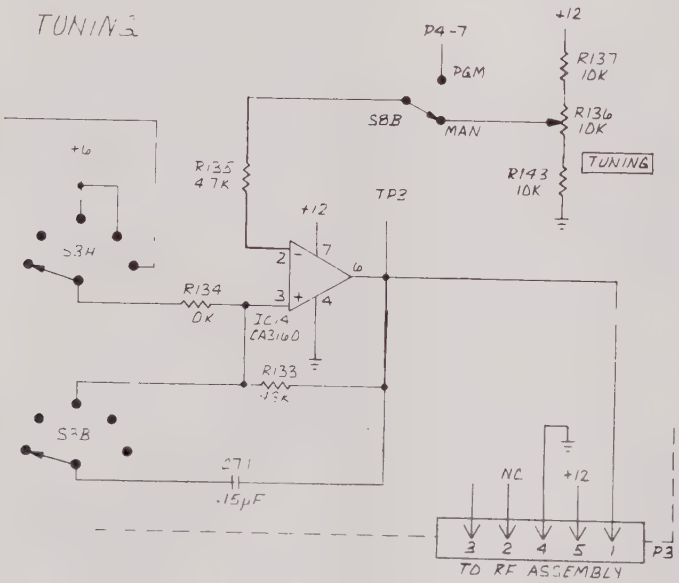
IC13B and IC13C form a ramp oscillator, whose frequency is varied by R118. This ramp voltage is applied to IC13D, where it is amplified to provide the horizontal drive required for the oscilloscope. The ramp output from IC13C is also applied to a separate amplifier of IC13A. The IC13A's output (an inverted ramp), is applied to the tuning circuit. The IC13A causes the 1st L.O. frequency to increase and decrease corresponding with the horizontal drive to the oscilloscope. The dispersion potentiometer (R125) is used to increase or decrease the amplitude of the ramp signal applied to the tuning section. This dispersion potentiometer allows for a small or large span of frequencies. The auto/manual switch (S5) allows the tuning voltage to be varied manually, by adjusting the manual sweep potentiometer (R118).



SPECTRUM ANALYZER

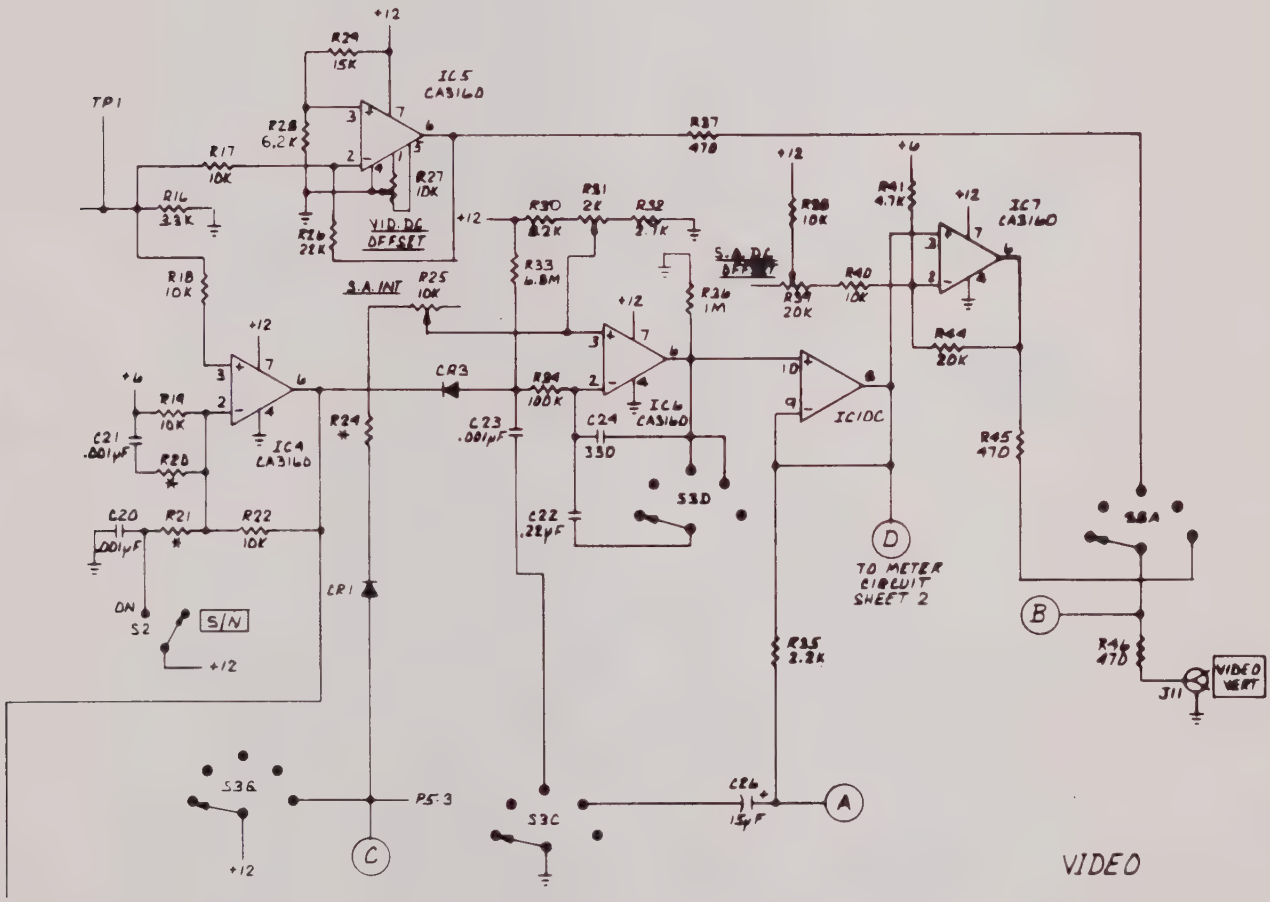
TUNING CIRCUIT

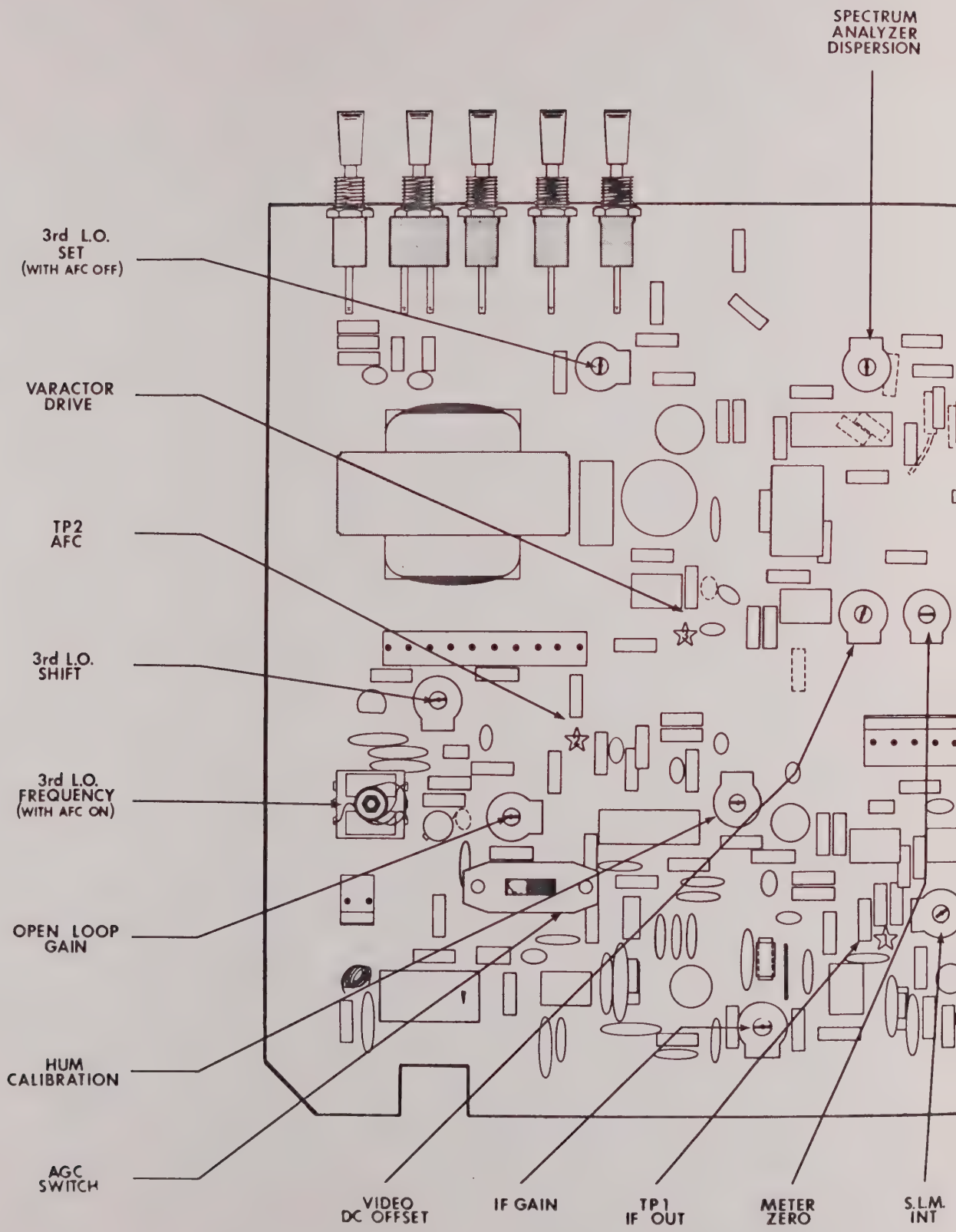
This circuit consists of a series of voltage divider networks, which can be switched between bands by S201. The two voltages, which are selected by S201 and applied to pin 5 of IC201A and pin 3 of IC201B, are buffered through the 1458 to provide isolation. These two outputs are then applied to R136 on the front panel. The wiper of R136 (course tuning potentiometer) will have a voltage corresponding to the band selected on the front panel. This voltage is amplified byIC14 and its output (pin 6) is then applied to RF assembly. R137 and the fine tuning potentiometer allow for a very small change in the output voltage.

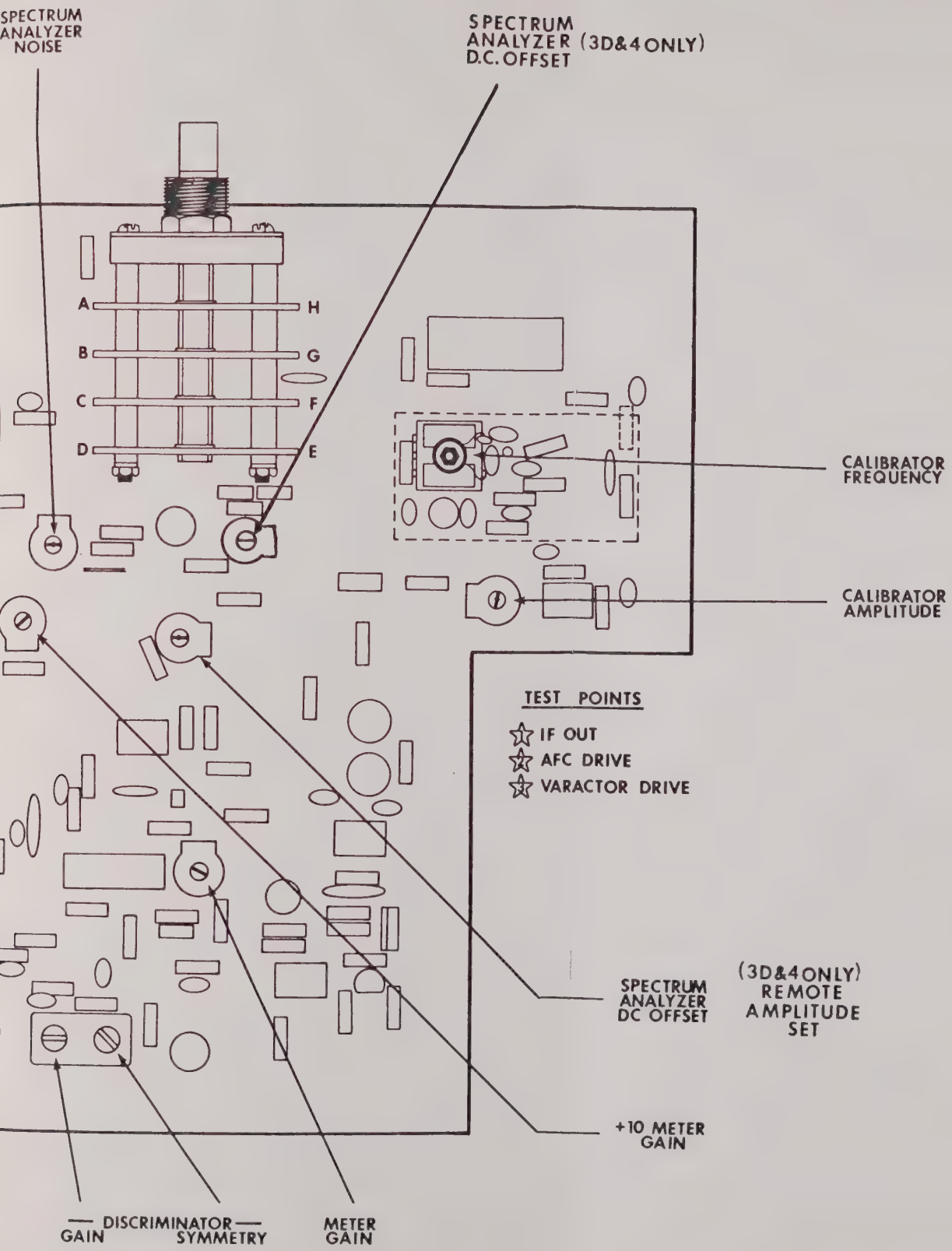


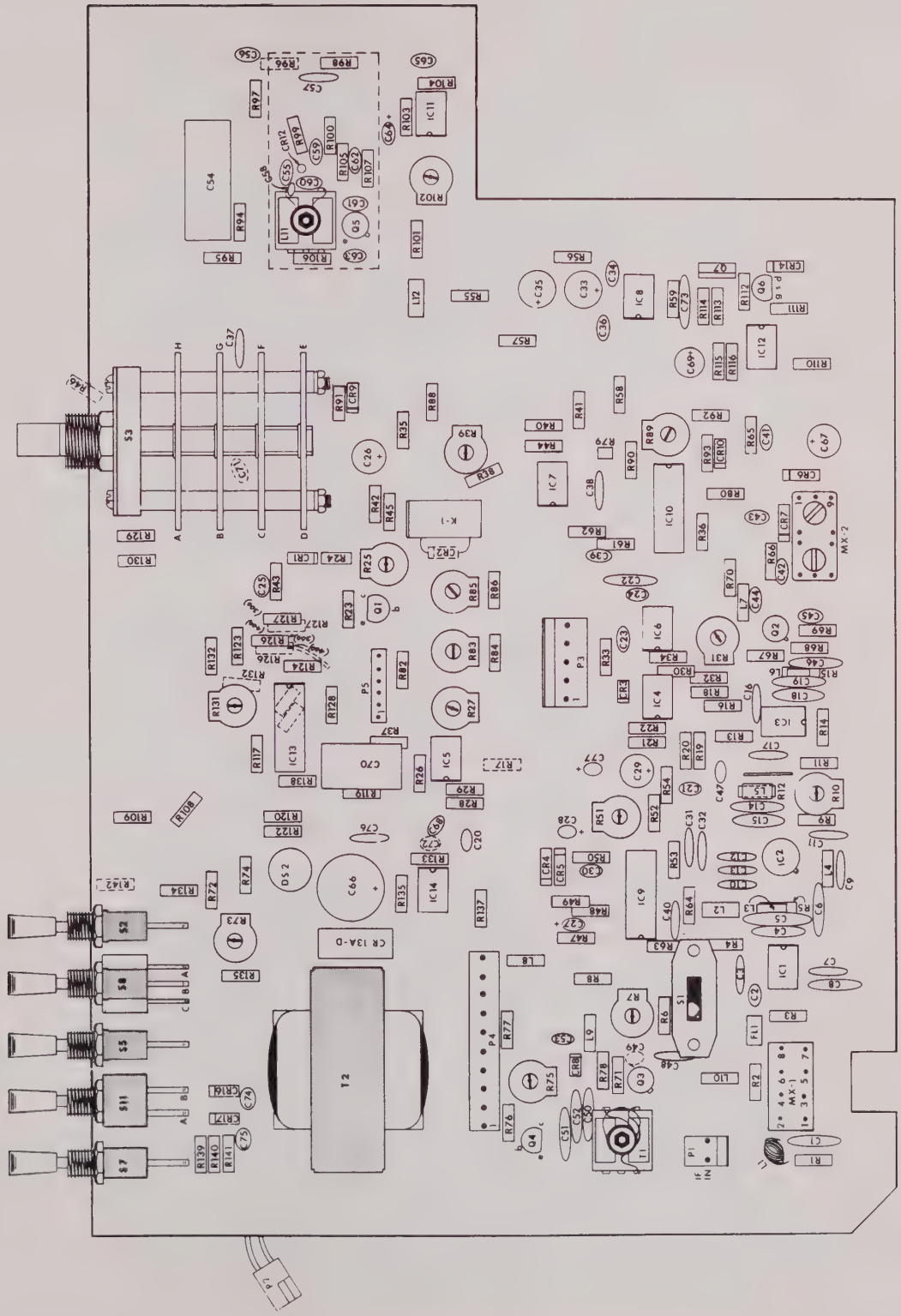
VERTICAL/VIDEO AMPS

The purpose is to provide a video output that can be monitored with an oscilloscope. The detected signal from IC3 pin 4 is amplified by IC5 and fed through S3A function switch to the front panel F connector. The combination of R28 and R29 and the DC offset potentiometer (R27) is to provide an offset voltage of approximately .2V. The IC7 provides the vertical output for the oscilloscope in the spectrum analyzer mode. The IC7 amplifies the AGC voltage from IC10C, pin 8. The R38, R39, R40 and R41 provide an offset voltage to place the baseline of the noise level at OV.




SPECTRUM ANALYZER DISPERSION
3rd L.O. SET (WITH AFC OFF)
VARACTOR DRIVE
TP2 AFC
3rd L.O. SHIFT
3rd L.O. FREQUENCY (WITH AFC ON)
OPEN LOOP GAIN
HUM CALIBRATION
AGC SWITCH
VIDEO DC OFFSET
IF GAIN
TP1 IF OUT
METER ZERO
S.L.M. INT


SPECTRUM ANALYZER NOISE
SPECTRUM ANALYZER (3D&4 ONLY) D.C. OFFSET
A
B
C
D
H
G
F
E
CALIBRATOR FREQUENCY
CALIBRATOR AMPLITUDE
TEST POINTS
IF OUT
AFC DRIVE
VARACTOR DRIVE
SPECTRUM ANALYZER DC OFFSET
(3D&4 ONLY) REMOTE AMPLITUDE SET
+10 METER GAIN
DISCRIMINATOR GAIN
DISCRIMINATOR SYMMETRY
METER GAIN



SAM II MAINBOARD PRELIMINARY CALIBRATION

I. Physical Inspection
   1) Examine unit for defects.

II. Voltmeter
   1) Place function switch to "volts" position.
   2) Connect a voltage source to the front panel voltmeter jacks and check meter reading. Accuracy must be ±5%.

III. Charge Circuit
   1) Plug A.C. charge cord into 110Vac and connect to the unit. Connect a dummy battery of 39V in place of a battery or power source.
   2) Turn unit on the "ON" charge and lamp on the main PCB should light. Turn unit off and the charge lamps should dim.

IV. Power Supply
   1) Connect battery cable to external power supply at 14V.
   2) Turn on power switch and check 6V supply for 5.58V to 61V.
   3) Connect voltmeter to 12V supply and select resistor value of R116 to read 12.0V to 12.1V.
   4) Place function switch in the "batt. chk" position and lower the voltage source to 12.5V The meter should read "recharge".
   5) Vary the voltage source from 12.5V to 16.0V. The supply should not change more than ±.005V.

V. Meter and Display Lights
   1) Turn on light switch, the two lamps in the meter should light.

VI. Varactor Drive
   1) Function switch needs to be in SLM mode.
   2) Connect a voltmeter to test point 3 (pin 6 of IC14). Turning the tuning potentiometer from one extreme to the other should produce a varactor drive voltage of 0 to 12V.(0=.05V maximum,12=11.8V minmum).

VII. Spectrum Analyzer
(Analyzer Units Only)
   1) Connect a scope probe from the demod input of an 1801 sweep generator to the horizontal output connector of the Sam.
   2) Set vertical sensitivity to 2V per division, and horizontal time base to 5ms.
   3) Place the function switch in Spectrum Analyzer mode.
   4) Place sweep rate/manual switch in the manual position. By varying manual control potentiometer, you should see a voltage go from 0 to 9V.
   5) Place sweep rate/manual switch in sweep rate position. By varying sweep rate control potentiometer, you should see a sawtooth waveform go from 0 to 9V with waveform varying from flat to full angle.

VIII. 3rd L.O.
   1) Must be in open loop.
   2) Place function switch in SLM position. Turn AFC on.

3) Connect a pick off loop to a frequency counter capable of reading 35.05 MHz.
4) Hold up the pick off loop near the 3rd L.O. tuning coil (T1), as far away as possible to maintain as accurate reading.
5) Using a tuning stick, adjust slug in coil (T1) for a frequency of 35.05 MHz. Turn off AFC and adjust R73 for 35.05 MHz.
6) Repeat step 5 above until AFC off and AFC on, both result in a frequency of 35.05 MHz ±.03 MHz.

IX. Sweep IF

1) Must be in open loop. (Open loop is achieved by placing slides switch S1 in its right side position)
2) Using an IF cable, inject a signal at the IF input on the mainboard.
3) Adjust sweep to center frequency of 45.75 MHz, sweep width 1MHz at +20 dBmV and sweep rate = 100 msec.
4) Connect a scope probe to video vertical connector on the Sam.
5) Set scope vertical position to .2 V per division.
6) Set the scopes horizontal input to .5 V per division and connect the scope to the horizontal output of the sweeper.

X. Video Offset

1) Must be in open loop.
2) Adjust R27 for a dc level of 1.V above ground.
3) Adjust R7 for an open loop gain for about a 1.V signal.

XI. AFC

1) Must be in open loop.
2) Connect scope probe to test point 2.
3) Set scope vertical to 1.V per division and adjust the pink slug of the discriminator for maximizing amplitude, and the blue slug for symetrical waveform. The signal should be at least 4 V peak to peak.

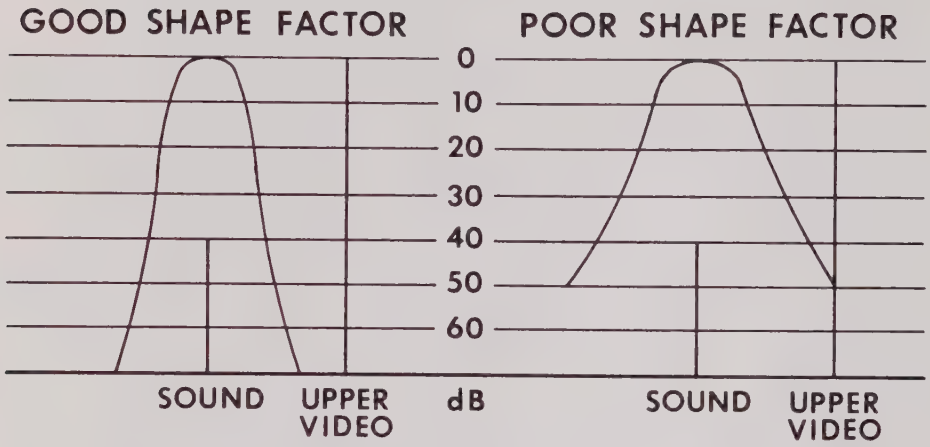
XII. Tune IF

1) Must be in open loop.
2) Re-connect the scope probe to the video vertical connector on the Sam.
3) Scope vertical sensitivity should be .2 V per division.
4) Using test probe, inject a signal at pin 1 of IC2 (1550).
5) Adjust sweep to 10.7 MHz center frequency, sweep width of about 1 MHz and amplitude to + 10 dBmV.
6) Select capacitance values across the 2nd and 3rd tank circuits in the IF, C15 and C18 until the response is centered a 10.7 MHz. Remove test probe.

XIII. Shaping Response

1) Must be in open loop
2) Using an IF cable, injust a signal at the IF input of the Sam.
3) Frequency should be at 45.75 MHz, sweep width = 1 MHz, at +20 dBmV.
4) If necessary, select a capacitor value C4 across the first IF tank circuit to acheive a flat or haystacked response, rather than a tilted, notched or pointed response. Solder capacitor in place.

REFER TO PICTURES BELOW FOR TYPICAL GOOD IF RESPONSE AND BAD IF RESPONSE



XIV. Open Loop Gain

1) Set scope vertical to 1 V per division and adjust the pink slug of the discriminator for maximizing amplitude, and the blue slug for a symetrical waveform. The signal should be at least 4V peak to peak.

XV. AFC

1) Must be in open loop.
2) Connect scope probe to test point 2.
3) Set scope vertical to 1 V per division and adjust the pink slug of the discriminator for maximizing amplitude, and the blue slug for symetrical waveform. The signal should be at least 4 V peak to peak.

XVI. Integrator

1) Must be in closed loop. (Slide switch S1 in its left side position)
2) Connect scope probe to test point 1, pin 4 of IC3 (1330).
3) Set scope vertical to .5 V per division, and adjust vertical position until an inverted response appears.
4) Close loop switch and place sweeper in manual sweep mode. Sweep through from no signal to a maximum signal. The maximum signal condition should lower the response by .4 V.
5) Adjust R31 for a .4 V difference.

XVII. Meter Tracking

1) Must be in closed loop.
2) Place function switch to the SLM mode, set potentiometers R81 (cal. set), R84 (10 dB gain), R87 (+10), R83 (-10) and IF gain to center of their positions.
3) Front panel +10 dB gain potentiometer should be in cal position.
4) Using an IF cable, inject a signal from an MC-50 or your meter calibrator,at 45.75 MHz and at +20 dBmV. Watch the meter, adjust frequency of MC-50 for maximum amplitude.
5) If necessary, select a resistor value R84 to achieve a mid scale reading.
6) Re-adjust frequency of MC-50 for a maximum meter reading and repeat step 5 above if necessary.
7) Reduce MC-50 amplitude by 10 dB and adjust R83 for a left scale reading. Return amplitude to original +20 dB.
8) Increase amplitude by 10 dB and adjust R85 for a right scale reading. Return amplitude to original +20 dB.
9) Repeat step 7 above.
10) Reduce amplitude by 10 dB and turn front panel +10 dB gain potentiometer fully clockwise and adjust R89 for a mid scale reading. Return front panel +10 dB gain potentiometer to "cal" position. Reset R83 to read left scale.
11) Repeat steps 7 and 10 above.

XVIII. Peak Detector

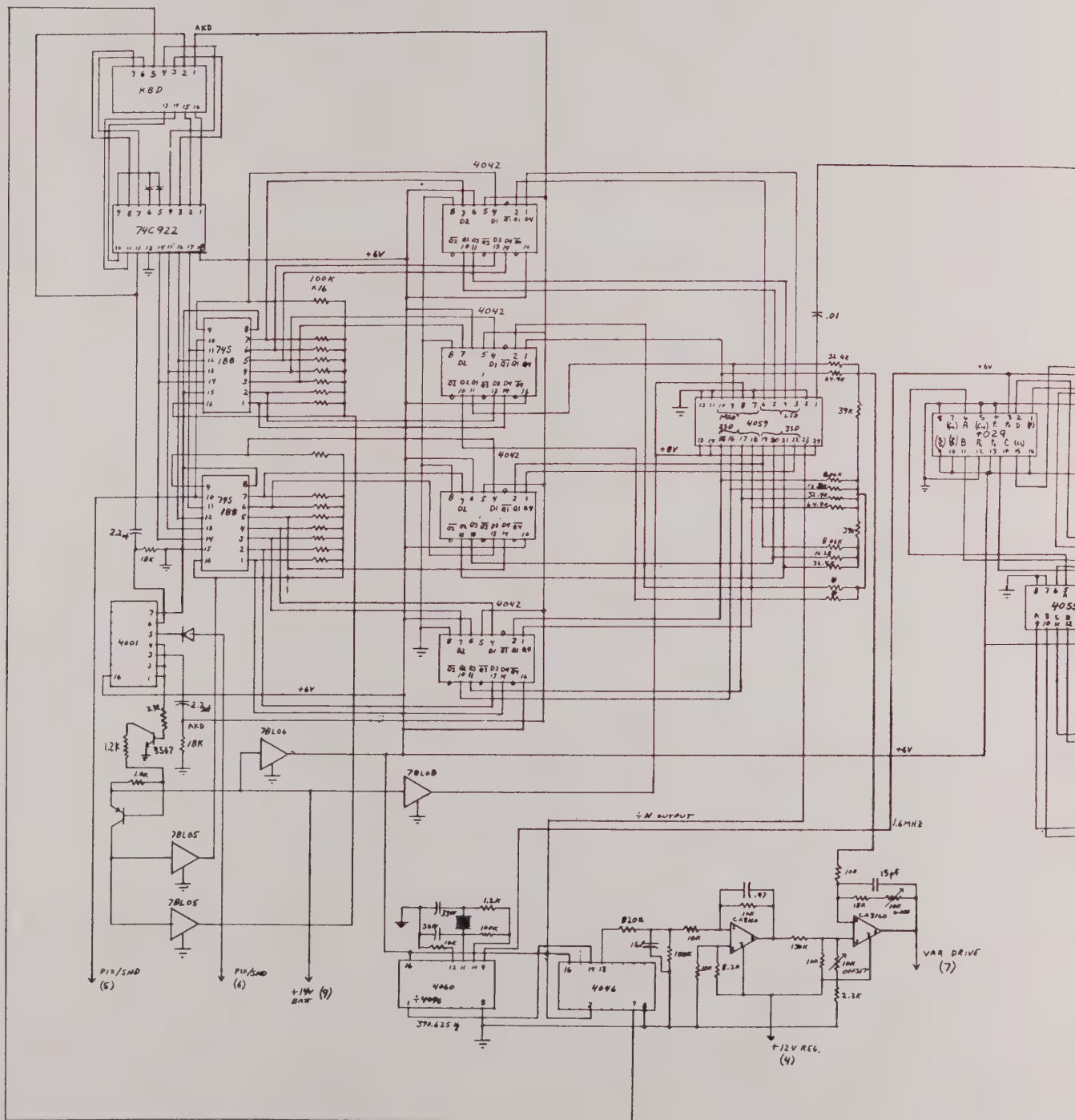
1) Connect an MC50 to the RF input of the Sam and peak on a signal. Press the modulation switch of the MC50, the needle of the meter should drop. Select a resistorand complete the circuit at position R20. Change the value of this resistor 27K ohm until a needle drop of no more than .2 dB is achieved.

XIX. Hum

1) Use 27K ohm resistor to complete circuit position R50, check circuit.
2) Adjust R51 for mid scale, then switch a calibrated hum source from 2% to 4% hum modulation.
3) Adjust hum R51 for 2% and 4% meter scale. If unable to center, raise or lower resistor.

XX. Calibrator

1) Connect the calibrator output to a frequency counter capable of measuring 150 MHz.
2) Adjust the oscillator tuning slug, L11 for a frequency of 150 MHz and verify that the calibrator amplitude R102 does not alter the frequency more than 2 MHz.
3) Connect the calibrator output to a Sam and adjust the calibrator amplitude R102 to achieve +20 dBmV. Verify that the potentiometer still has ±2 dB of range, minimum.
4) Solder calibrator shielding can in place reset the frequency to 150 MHz ±.1 MHz.


AKD
KBD
74C922
4042
4042
4042
4042
100K
X16
74S
188
74S
188
.01
4059
4029
2.2μ
18K
4001
+6V
3.3K
1.2K
3567
1.8K
AKD
18K
2.2μ
78L06
78L08
78L05
78L05
÷N OUTPUT
1.6MHz
PLL/SMD
(5)
PLL/SMD
(6)
+14V
BAT (9)
330
50K
1.2K
100K
4060
÷4096
370.625 H
4046
8.2K
CA3140
CA3140
13pF
2.2K
+12V REG.
(4)
VAR DRIVE
(7)

REVISIONS			
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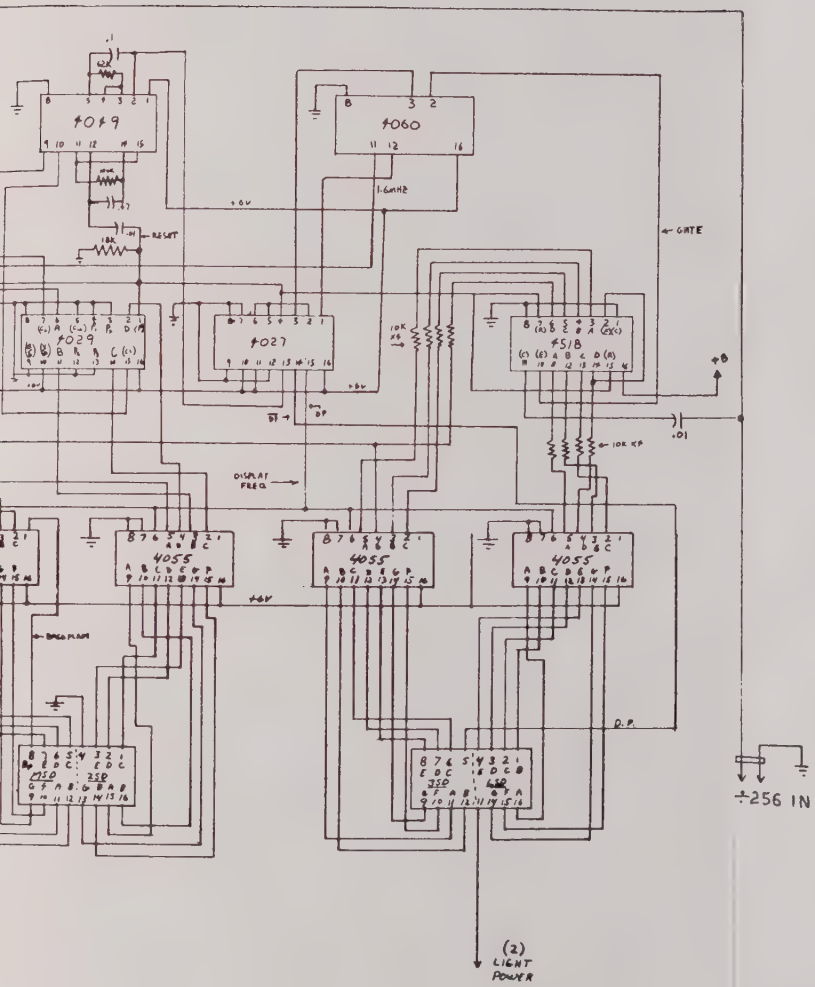


SAM II DIGITAL BOARD 25

SCALE	APPROVED BY	DRAWN BY
DATE: 1-1-80		

UHF/VHF DIRECT FREQ. READOUT

DRAWING NUMBER 080-0410

THEORY OF OPERATION

SAM II DIGITAL BOARD-MANUAL TUNING

The Sam II digital board is divided into two seperate sections. The first section being a frequency counter, which contains the circuitry necessary to count, latch and display the frequency at which the Sam II is tuned. The second section is a frequency synthesis circuit. This circuitry allows a channel to be selected via a keyboard, then tunes the Sam to this frequency and locks.

The frequency counter section will be covered first, since it is functioning in both the manual mode and the program mode of operation. It is first necessary to realize that the frequency counter section really begins with a divide by 256 counter located in the 1st L.O., the frequency of which is 460 MHz higher than the frequency that the Sam is tuned to.

The output of the divide by 256 signal is applied to a chain of decade counters, IC20, IC23, and IC29. The frequency range of this signal would be from a minimum of 460/256=1.7968 MHz to a maximum of 1350/256=5.1953 MHz on a UHF unit. As the frequency is being tuned, IC29 will count from 0 to 9, it will then reset back to OV. At this same time a set pulse is enabled out pin 6 of IC29. This pulse is applied to a digital inverter IC22 pin 9. This pulse is inverted out pin 10 and applied to the next decade counter IC23 pin 15. As this counter goes from a count of 9 to 0, a set pulse is applied to the next decade counter IC20 pin 15 from IC23 pin 7. As the signal is being counted by the decade counters the binary outputs are applied to 4 binary coded decimal to seven segment display drivers IC21 (most significant digit), IC24 (3rd significant digit), IC28 (2nd significant digit), and IC30 (least significant digit). The decoded outputs are then routed to the LCD display PCB by a pair of 16 pin ribbon cables. It must be noted that IC32 which sends IC30 (least significant digit) its BCD data is disabled ind the program mode by applying +6 Vdc via the program/manual switch on the front panel.

Since the decade counters are counting a function of the 1st local oscillator, which is 400 (or 460) MHz above the desired tuning frequency, a means of offsetting the counters by this amount is required. This is accomplished by loading the counters with a value upon being reset. With a 400 MHz 1st IF the most significant counter is loaded with a binary 12 (1100), thus when the counters count 400 cycles, the counters will reach their maximum count and begin at 0 to count the frequency. On a unit with a 460 MHz IF (400 and 450 MHz range units) a binary 11 (1011) is loaded into the most significant counter and a 4 (0100) is loaded into the second significant counter.

As with any frequency counter, there must be a master clock and reset signal to allow the decade counters to count for a precise amount of time. This clock circuitry begins with a 4 MHz oscillator consisting of a 4 MHz crystal and a digital inverter. This 4 MHz signal is then fed to a seperate binary counter with two outputs. One is used in the frequency synthesis mode and will be discussed later. The output we are concerned with at this time is 400 kHz (pin 11 of IC19). This 400 kHz signal is applied to a binary counter, (IC26). When the binary counter reaches a count which allows output Q10 (pin 15) to go high, the decade counters are enabled, (the counter enable pin is pin 10 of IC29) allowing them to count the 256 prescaled signal. When a count is reached that allows output Q11 (pin 1) of binary counter IC26 to go high, the J-K flip flop (IC27) will toggle, output Q (pin 1) goes high, resetting the binary counter (IC26) which disables the decade counters, thus latching the display.

The -Q output to the flip flop (pin 2 of IC27) goes low, keeping J & K low, prohibiting any further changes in the outputs of the flip flop. It is precision timing, the time that Q10 (pin 15 of IC26) remains high (approximately 1.5ms.), that allows the decade counters to count the proper amount of time.

A free running oscillator consisting of 2 digital inverter gates from IC22 and R42, R43, C16, and C17 generates the reset pulse (a short spike with approximately 100 ms, repetition time). This reset pulse is applied to the J-K flip flop (pin 4 of IC27) and to the chain of decade counters (pins 7 & 15 of IC29 and pin 1 of IC20, and IC 23). After the flip flop and decade counters are reset, the cycle then repeats.

A second free running oscillator consists of 2 digital inverter gates from IC22 and R41, C15. This signal (about 83 Hz square wave) is applied to a second J-K flip flop (second half of IC27) connected as a divide by 2 counter (input on pin 13, output on pin 15). This output is applied to the BCD to seven segment decoder drivers (IC21,IC24,IC28, IC30) to be used as a display frequency or backplane.

SAM II DIGITAL BOARD PROGRAM TUNING

The frequency synthesis section of the digital board is used in the program mode to tune the Sam 1st L.O. to a pre-programmed frequency. There are 32 possible frequencies, pre-programmed at the factory in 2 proms, IC3, and IC4. There are 5 address lines required to address 32 channels, 4 of which are generated by the keyboard circuit, and the fifth by th PIX/SND switch. When a button is touched on the keyboard, the keyboard encoder (IC1) places a binary ouput on pins 14,15,16, and 17, corresponding to the button which was depressed. A TTL high is present on pin 12 as long as a key is being depressed. This signal is differentiated by C12 and R2. This short duration pulse is applied to a digital nor gate (IC5, pin 9) which essentially functions as an inverter. This ouput (pin 10) is applied to another nor gate (pins 12,13) which again acts as an inverter. This output (pin 11) is applied to yet another nor gate (pin 6) along with another signal on pin 5. This signal is a short pulse that is generated each time the PIX/SND switch is operated. Either the keyboard pulse or the PIX/SND switch will cause a brief TTL low on the output of this nor gate (pin 4). This signal is again fed to a nor gate (pins 1 and 2) wired as an inverter. This output (pin 3), which is a short duration pulse is applied to the base of transistor Q1, causing it to conduct. This supplies a ground path for R4, pulling the base of Q2 low, causing it to conduct. This supplies battery voltage to the proms. Each time a button is pressed or the PIX/SND switch is toggled, power is supplied to the proms briefly (about 25 ms). It is necessary to leave the proms unpowered at all times except when reading channel data from them, since they draw almost 100 mA from the battery which would reduce the battery life of the unit to about an hour. The pulse generated at the ouput of IC5 pin 3 is differentiated by C3, R5. This short pulse is then applied to the four data latches (IC10,11,12,13 pin 5). This is the latch enable pulse that allows the latches to receive the data output from the proms. It is important that this pulse does not decay until after the proms have been powered up for 2 ms, and that it does not decay before the proms are powered down. If not, the latches will not latch onto the correct data that is really stored in the proms.

The data now latched in the four latches is applied to a digital to analog converter consisting of R8 through R16. This voltage is amplified by IC18 and

its output (pin 6) is routed to the main-board varactor drive amp. This tunes the 1st L.O. approximately to the frequency desired. The data from the latches is also applied to a divide by N counter (IC15) which divides the 256 signal from the R.F. This output (pin 23) is one input to a phase comparator (pin 3 of IC16). The other input (pin 14) is a 2 kHz square wave generated by dividing the 2 MHz signal discussed earlier by a binary counter (IC14, pin 11 input, pin 15 output). The phase comarator (IC16) compares these two frequencies and provides an output (pin 13) that is high if the input from the divide by N counter is lower than 2 kHz. Likewise pin 13 will go low if the divide by N frequency is higher than 2 kHz. This output is amplified by IC17 and summed with the output of the digital to analog converter. The result of this action is to lock the SAM L.O. onto the the exact frequency by a phased lock loop. Because the divide by 256 signal must be divided by IC15 to a frequency of 2 kHz in order to lock, and only frequencies ending on an even .5 MHz can be divided to exactly 2 kHz, the SAM II cannot directly tune to a frequency ending in anything other than a function of .5 MHz. To allow the Sam to read channels ending in a function of .25 MHz (most normal U.S. channels do), the proms contain data that allows the phase locked loop to tune to the closest .5 MHz, then a special bit is used in the prom which causes the SAMS 3rd L.O. to shift 250 kHz (this will appear on pin 11 of IC 11 to pin 8 of the mainboard connector). The effect is to tune the SAM to the correct frequency by a combination of the 1st L.O. and the 3rd L.O. since the LCD display would read only the closest .5 MHz under these conditions, (250 kHz off).

SAM II TUNING BOARD DIGITAL BOARD

SAM II tuning board calibration is obtained by adjusting the DC offset and gain controls in the summation circuitry of the synthesizer, while monitoring the phase detector's output voltage.

1. Connect an oscilloscope to the phase detector test point TP-4.
2. Set oscilloscope vertical to 1 V per division and horizontal to 2 ms per division.
3. Check the phase detector's output voltage on all keyboard selections, pix and sound, noting the frequency where the highest and lowest readings are obtained. The phase detector's range is optimized when the output voltage is 2.5 V. Normal circuitry nonlinearity will cause the phase detector voltage to change to compensate for linearity changes in the tuning circuitry. Throughout all keyboard selections the phase detector's output voltage should remain between 1.5 V and 4 V. If this is not the case proceed to step four.
4. Select the highest frequency on the keyboard that does not meet the phase detector output voltage specification (2.5 V ± 1 V).
5. Adjust the "phase detector offset" control on the SAM II tuning board to bring this selection into specifications.
6. Select the lowest frequency on the keyboard that does not meet the specifications.
7. Adjust the "phase detector gain" control until the phase detector's output voltage is in specifications.
8. Repeat steps three through seven until all keyboard selections are within specification.

NOTE:

IF ONLY ONE FREQUENCY IS OUT OF SPECIFICATION, USE THE TWO SELECTIONS ON THE KEYBOARD THAT ARE THE MOST EXTREME VARIATIONS FROM THE 2.5 V OPTIMUM PHASE DETECTOR OUTPUT VOLTAGE.

SAM II CALIBRATION

I. Power supplies
   1) Check +6 Vdc and +12 Vdc power supplies. Should be ± .1 Vdc
      a. Changing the value of R116 will adjust the +12 Vdc supply.

II. 3rd L.O.
   1) Must be in manual mode with no signal applied.
   2) Connect a pick off loop to a frequency counter.
   3) Sample the frequency of T1 and adjust if needed to have a frequency of 35.05 MHz with AFC on.
   4) With AFC off adjust R73 for a frequency of 35.05 MHz.

III. 2nd L.O.
   1) All Sam II meters have a crystal controlled 2nd L.O.
   2) For a 300 MHz unit the 2nd L.O. frequency should be 354.25 MHz.
   3) For a 400 MHz unit the 2nd L.O. frequency should be 414.25 MHz.
   4) Connect a cable from a frequency counter to the "F" connector on the bottom of the R.F. assembly. This is located near the right hand corner of the R.F.

IV. R.F. Gain, Flatness, and Sweep Width
   1) Connect an I.F. cable from an 1801 sweep generator, R.F. out port, to the I.F. in on the mainboard of the Sam.
      a. The generator should be set for an output of +20 dB at 45.75 MHz
      b. Connect a cable from the "demod in" to "video vert." on the front panel.
      c. Place the unit in open loop via S1 on the mainboard.
      d. Set the scope for an X-Y display with the horizontal out of the generator to the horizontal amp of the scope.
      e. Connect the vertical out to the generator to the vertical amp of the scope.
      f. Set the scope to .2 V per division, also DC coupled.
      g. Set the generator to 100 msec. sweep, with sweep time and sweep width for approximately 80 MHz.
      h. Adjust R7 (open loop gain) for a signal at approximately .1 V.
   2) Disconnect the I.F. cable from the sweep generator and replace it with the I.F. cable from the R.F. assembly.
      a. Connect the R.F. out cable from the generator into the R.F. in connector on the Sam.
      b. Place the Sam attenuator to +20 dBmV-mid scale position.
      c. Tune the generator to 150 MHz at +20 dBmV.
      d. Tune the Sam to 150 MHz in manual mode. Observe the signal.
      e. Peak all tuning caps and coils on the R.F. assembly starting with the one at the left front of the R.F.
      f. Adjust R7 again after this for 1 V signal. You should be observing an R.F. signal approximately 36 to 40 dBmV.
      g. Adjust R7 agin after this for 1 V signal. This finishes R.F. gain check.
   3) To check the flatness use your reference voltage of 1 V.

a. Start by tuning the Sam and the sweep generator together down in frequency. Watch the scope and observe the amplitude, it should not change more than ±.7 dBmV from 10 MHz to the top range of your meter.
b. Observe the sweep to also insure that the weep width goes down to -10 to -12 MHz and up past the top range of your meter plus about 12 MHz.

4) UHF Calibration
a. Check UHF Flatness by first switching the Sam into UHF. Connect the 1801 sweeper to the RF input of the Sam. Set a 1 V refference at 471 MHz, sweep up to 890 MHz. The signal cannot very more than +3 dB.
b. The flattness characteristics of the UHF L.O. are very different than that of the VHF L.O. therefore in some cases a UHF meter compensation resistor is needed. With the unit in closed loop peak up on a 150 MHz +20 dB signal from a MC50.
c. Use the calibration set pot to set the meter right at 20 dB. Remove the MC50 and connect the 1801 sweeper to the Sam.
d. With the 1801 in manual sweep to 150 MHz and set the variable attenuator of the 1801 so that the Sam meter reads exactly 20 dB. Switch the Sam into UHF and using the 1801 find the highest meter reading and the lowest meter reading between 471 MHz and 890 MHz. If these readings are within ±1.5 dB of the 20 dB reference, no compensation resistor is needed. If however the lowest UHF reading is not within 1.5 dB of 20 dB select a resistor of 1 M and place it in position R80. Repeat the a bove steps, being sure to reset the 150 MHz 20 dB reference. If the lowest UHF reading is still not within 1.5 dB of 20 dB, reduce the value of resistor R80. Make sure you check the highest UHF reading to see that it is not more than 1.5 dB greater than 20 dB. If you are unable to get the UHF readings within ±1.5 dB of 20 dB, the UHF L.O board requires work and must be sent to the factory for repair.

V. AFC
1) Connect the scope probe to IC9 pin 1, set the scope to 1 V per division.
2) Tune the Sam and 1801 sweeper to 150 MHz at +20 dBmV.
3) Tune MX1 (discriminator coil) blue coil for a symmetrical signal, and adjust the pink coil for maximum amplitude-may need to adjust the blue coil again.

VI. Integrator
1) Must be in closed loop. Connect scope probe to test point 1, pin 4 of IC3.
2) Set scope vertical to .5 V per division, and adjust vertical position until an inverted response appears.
3) Put in closed loop and place the sweeper in manual sweep mode. Sweep through from no signal to a frequency maximum signal. The maximum signal condition should lower the response by .4 V difference

VII. Meter Tracking

1) Set the +10 dB gain potentiometer to calibration position and the calibration set potentiometer to midrange.
2) R84 will be approximately a 220 K ohm resistor.
3) Set the Sam attenuator to the +30 dBmV mid scale, and adjust R83 for a +20 dBmV reading on the left side of the meter movement.
4) Set the Sam attenuator to the +20 dBmV mid scale, and adjust R89 for a +20 dBmV scale reading.
5) Turn +10 dBmV potentiometer on the front panel all the way clockwise and adjust the Sam attenuator to +30 dBmV mid scale reading. Adjust R85 for a +30 dBmV reading.
6) Set the Sam attenuator to +40 dBmV mid scale reading and adjust R10 if necessary to make minor adjustment to low end. Go to the +20 dBmV attenuator setting a mid scale and check high end reading.

VIII. Peak Detector

1) R20 is selected to be approximately 22K to 39K ohm resistor.
2) Connect your MC-50 preferably (meter calibrator) out to the Sam R.F. in.
3) Tune your calibrator to 150 MHz at +20 dBmV.
4) Tune the Sam to 150 MHz and peak on the signal.
5) Turn TV modulation on, and the signal on the Sam should read +19.75 dBmV to +20 dBmV. If you do not have the reading in this window of range then change the value of R20.

IX. Hum

1) R50 is selected for hum to be 80K ±20K ohm.
2) Connect your hum source.
3) Tune the Sam to the frequency of the source.
4) Switch to hum. The needle will peg momentarily. The low level will read less than .5%, the next level will be 2% ±.25%, and the last level will be 4% ±.25%. Adjust R51 as needed to acheive these levels.

X. Analyzer

1) CR1 and R24 are selected for the analyzer circuit. CR1 is a IN914 diode, and R24 is typically between a 18K to 24K ohm resistor.
2) Adjust your scope for X-Y display, plug cable from the Sam horizontal to scope horizontal.
3) Connect the video vertical on the Sam to the vertical on the scope.
4) Set the scope to .5V per division.
5) Set the Sam function switch to analyzer and manual/sweep switch to sweep.
6) Set the sweep rate fully clockwise and dispersion fully clockwise on the Sam.
7) Adjust R25 for the noise level of .4V to .6V.
8) Adjust R39 DC level potentiometer for the lower peaks to be cut off.
9) Using your dispersion control should allow you to see 0 MHz to the top frequency your particular meter is specified for.
10) All spurs should be at least 20 dB down from your reference signal at +20 dB.

XI. S/N

1) Tune Sam to your calibrated frequency ours is at (63 MHz) to achieve a peak reading. Select R21 typically on 80K ohm ±20K ohm for a S/N reading after depressing switch to be ±1 dB from your standard.

XII. Video

1) Connect the video signal to the RF in on the Sam.
2) Connect the video vert on the Sam to the vertical on the scope at .1V per division.
3) Adjust R27 for 85% scope reading on the video Portion of the signal.
4) The signal should be .1V out of DC level and be .7 cm high with the peaks touching .1V and .8V respectively.

XIII. Spurs

1) Turn the +10dB gain potentiometer on the front panel all the way clockwise and set the attenuator to the lowest scale (-20dB).
2) Tune the Sam from 4.0 MHz to the highest frequency of your meter, you should not see any meter deflection.

XIV. Voltmeter

1) Place function switch to the voltmeter position.
2) Connect AC and DC voltage, they in should be ±5%.

XV. Frequency Accuracy

1) Connect MC-50 or meter calibrator to RF in on Sam at 150 MHz at +20 dB.
2) Tune in Sam for reading at 150 MHz with AFC off. If the signal doesn't peak, tune T1 on mainboard until the signal peaks.
3) Tune in Sam now with AFC on, the needle should not move. If it moves down, tune the blue slug of the Mx1 discriminator until the needle peaks.
4) If the needle moves up when you try to peak on the signal, turn AFC off and peak on signal at 150 MHz at +20 dBmV, then turn AFC on again.<u>DO NOT TRY TO REPEAK THE SAM.</u> At this time repeak the R.F. tuning caps on the R.F. assembly.

XVI Charging Circuit

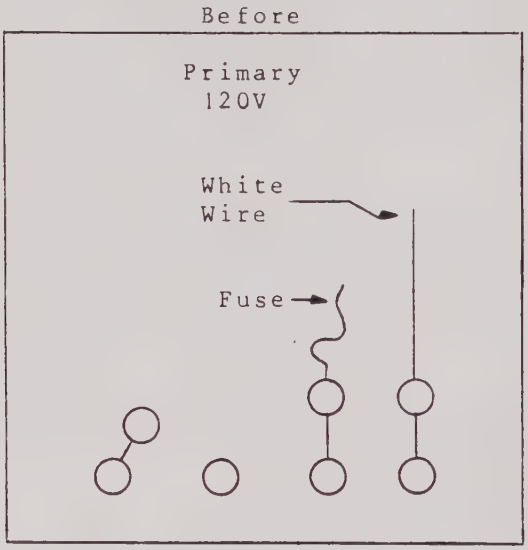
1) With the Sam connected to an external power supply, it will consume approximately 300 mA, this is with the light switch on and the volume turned fully on.
2) Plug in the AC charge plug to the Sam, observe the power supply-the current should drop to approximately 150 MA. At this time both the inside charge light and the front panel charge light should be on.

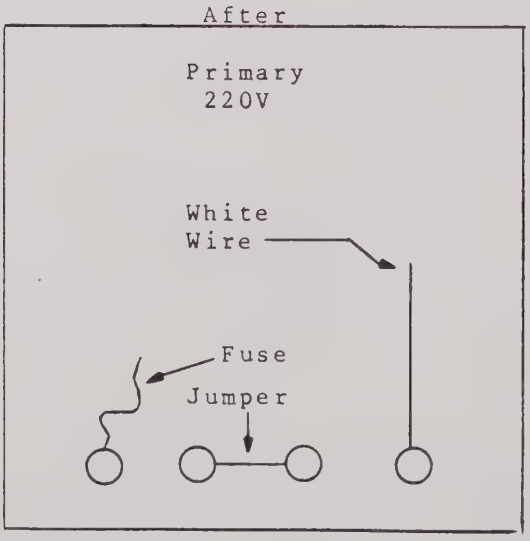
XVII Calibrator

1) Connect a cable from a frequency counter to the calibrator out on the Sam.
2) Adjust L11 on the Sam mainboard for 150 MHz ±.1 MHz.
3) Adjust R102 for +20 dBmV on the meter.

SAM CONVERSION FROM 120V to 220V

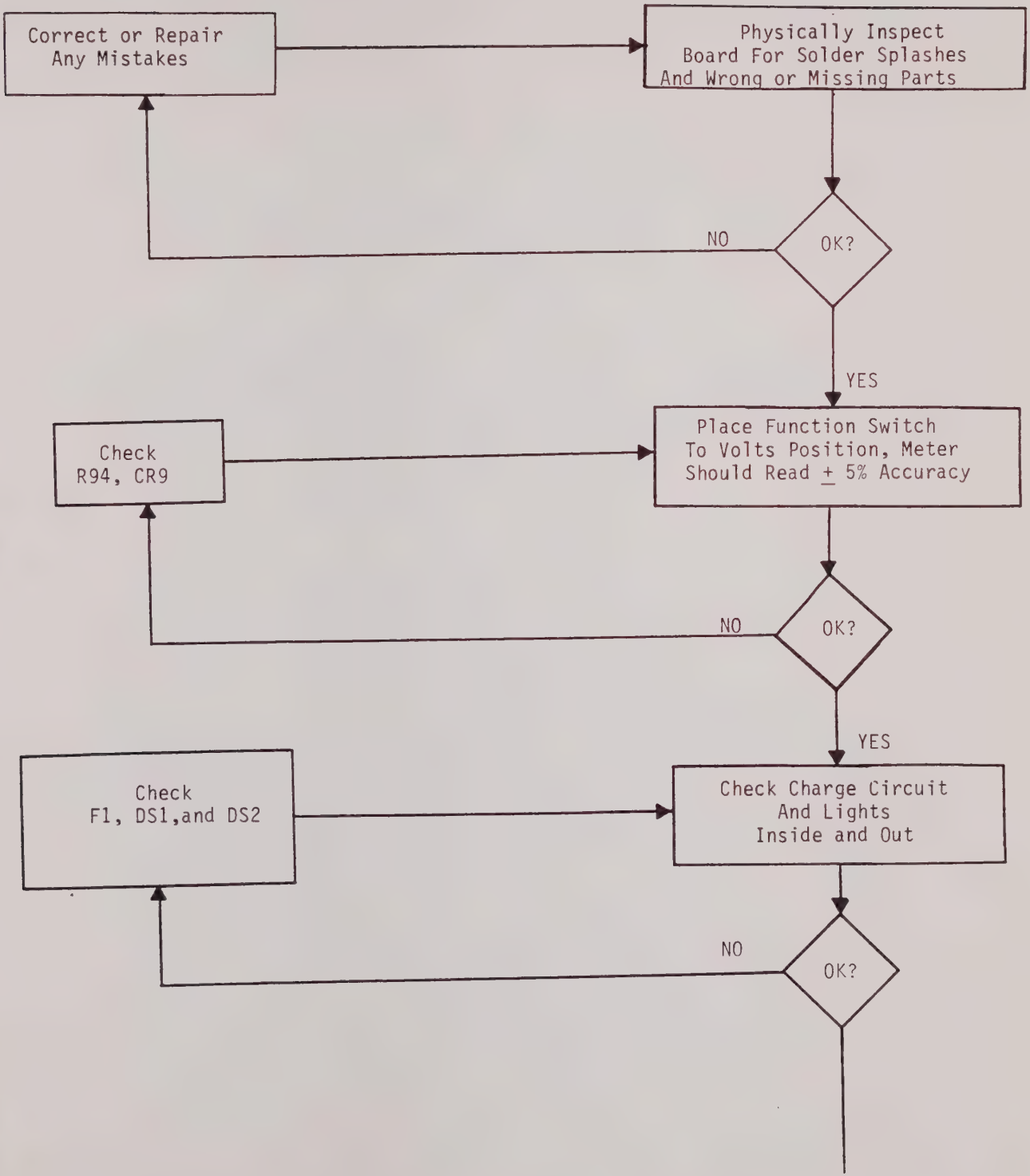
(Charge Circuit)

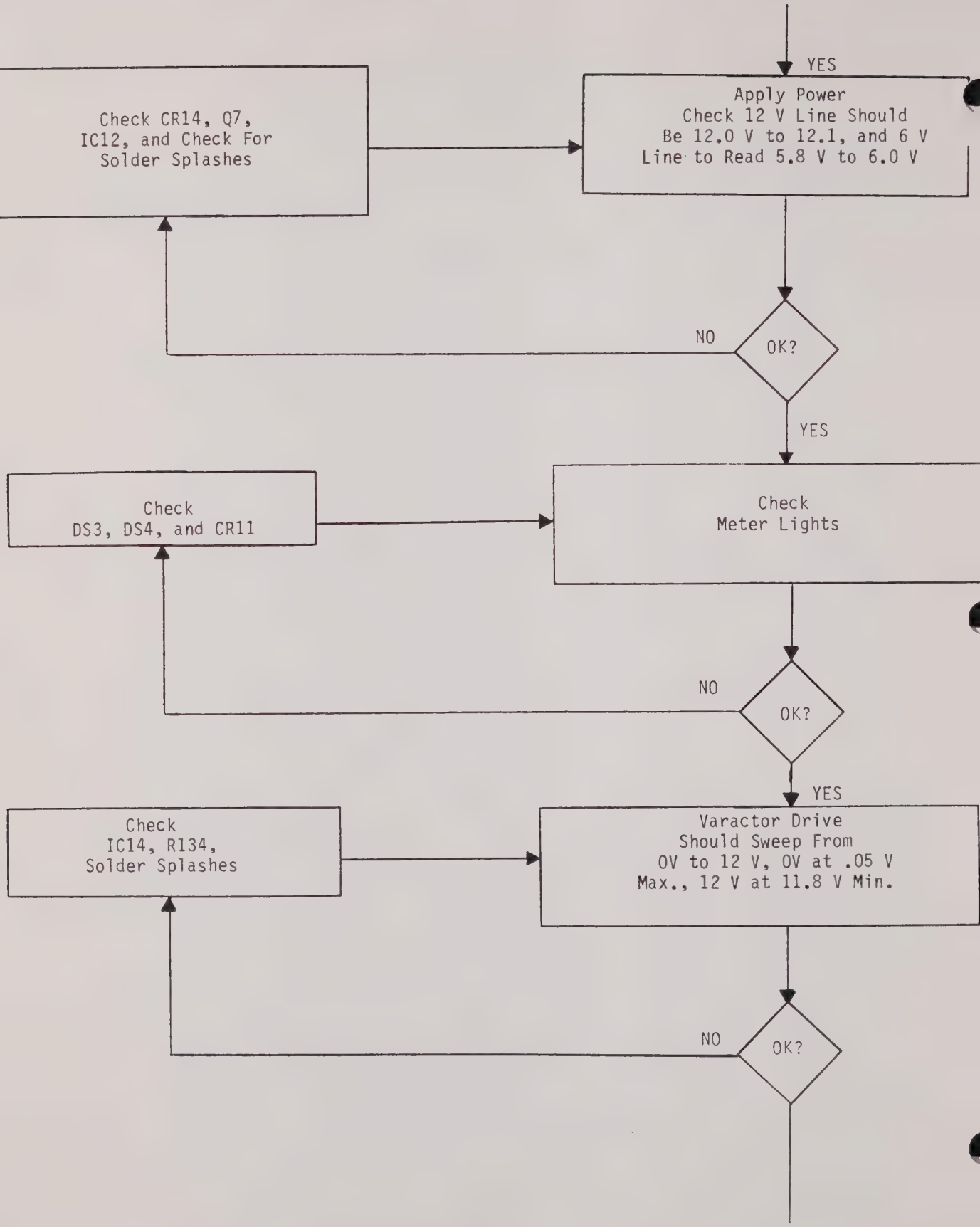




SAM MAIN BOARD

(Troubleshooting)

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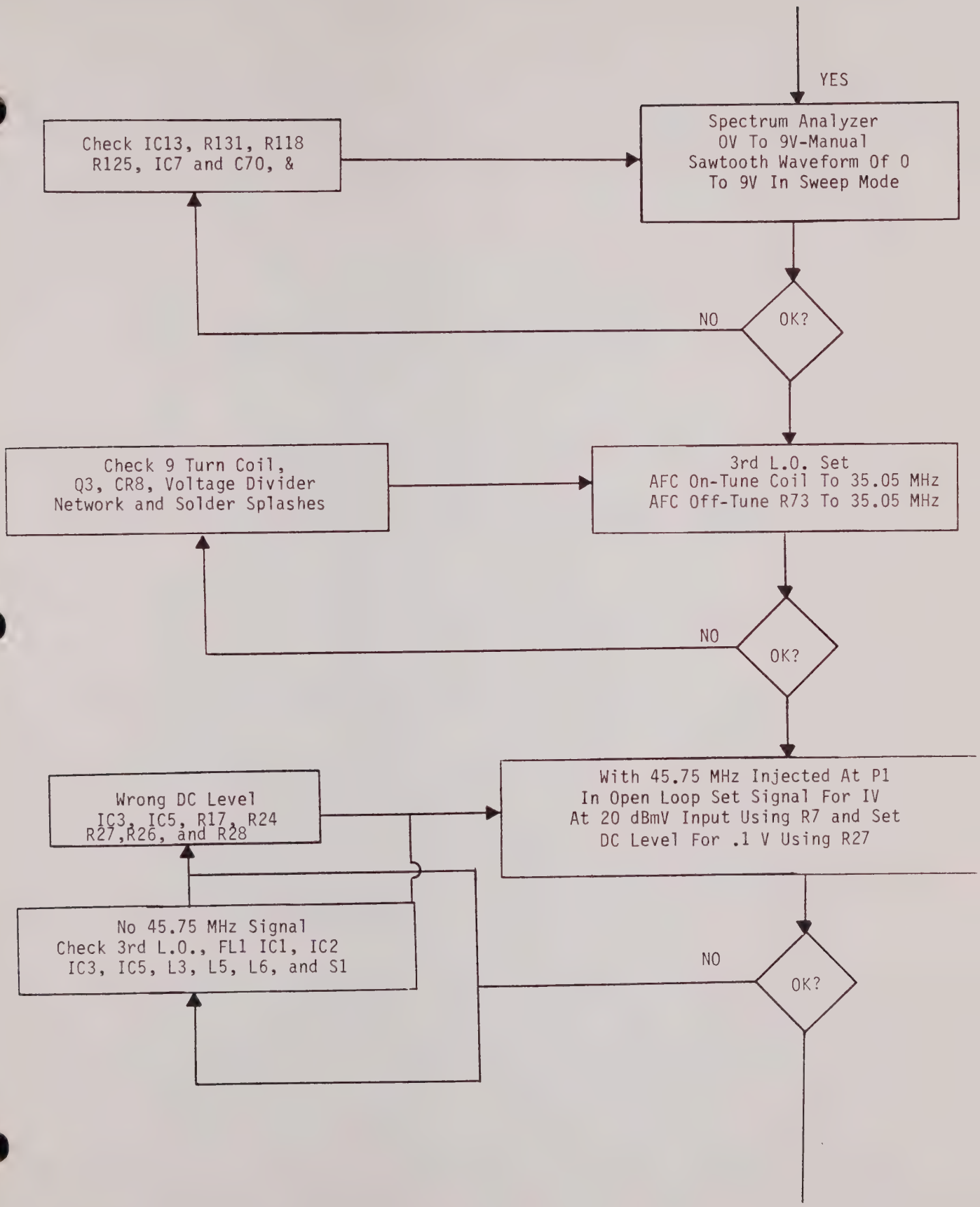
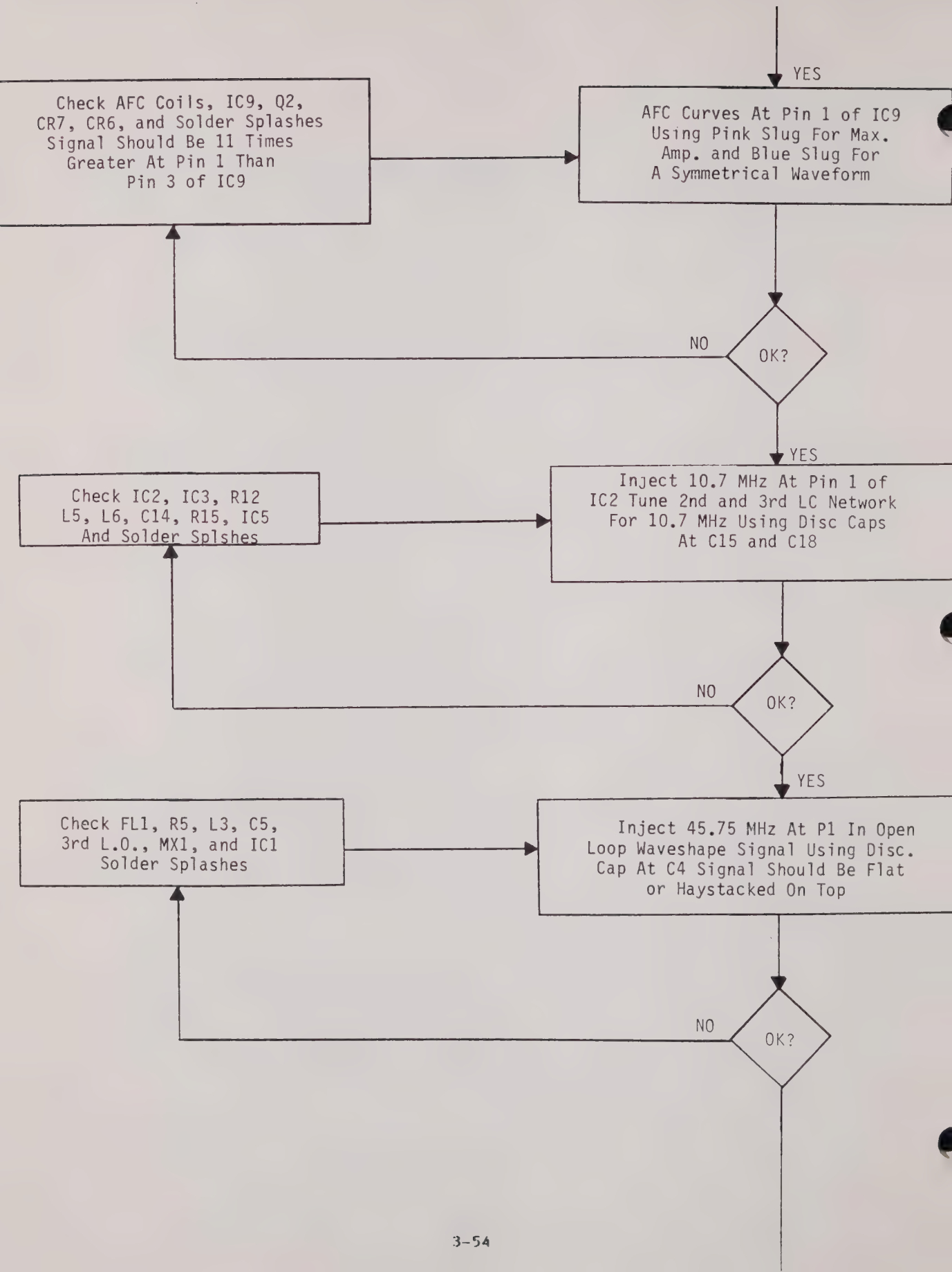
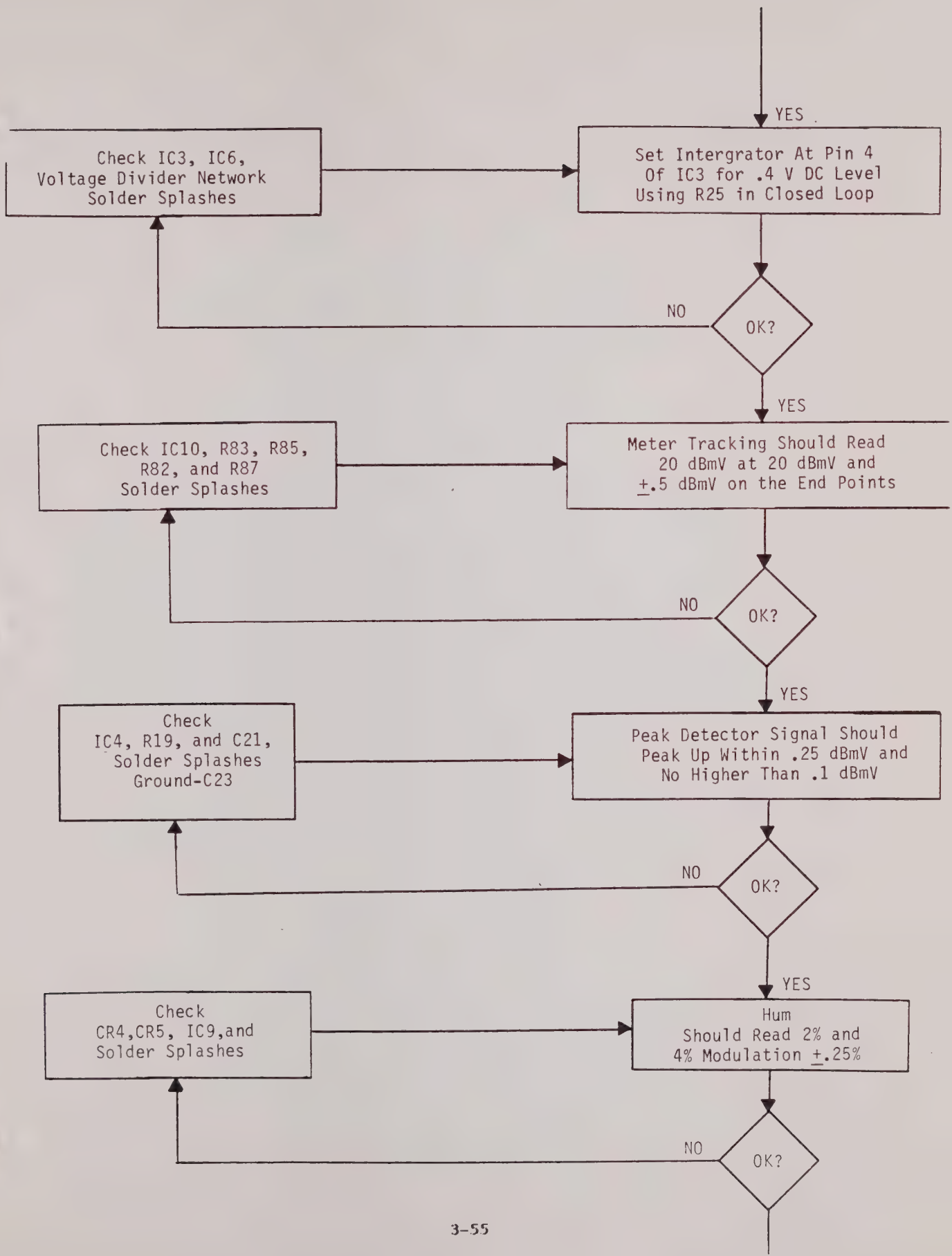
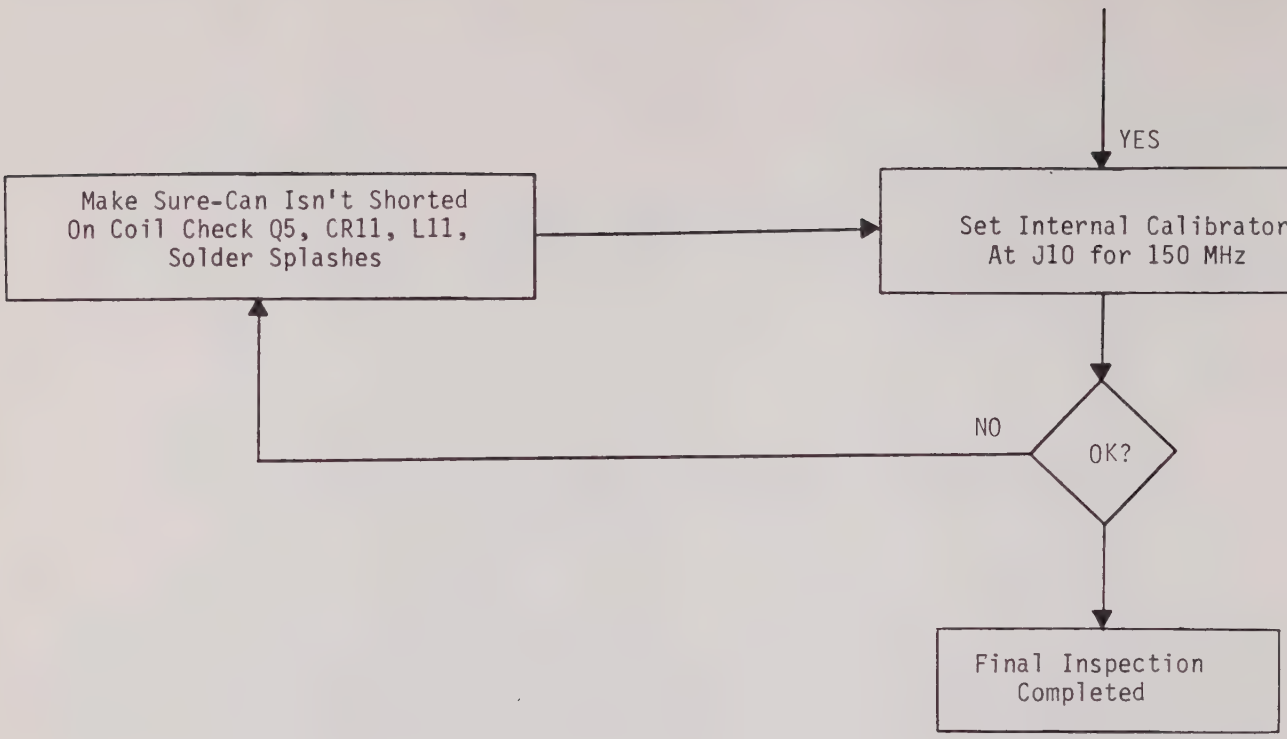
Apply Power
Check 12 V Line Should
Be 12.0 V to 12.1, and 6 V
Line to Read 5.8 V to 6.0 V
Check CR14, Q7,
IC12, and Check For
Solder Splashes
NO
OK?
YES
Check
Meter Lights
Check
DS3, DS4, and CR11
NO
OK?
YES
Varactor Drive
Should Sweep From
OV to 12 V, OV at .05 V
Max., 12 V at 11.8 V Min.
Check
IC14, R134,
Solder Splashes
NO
OK?


YES
Spectrum Analyzer
0V To 9V-Manual
Sawtooth Waveform Of 0
To 9V In Sweep Mode
OK?
NO
Check IC13, R131, R118
R125, IC7 and C70, &
3rd L.O. Set
AFC On-Tune Coil To 35.05 MHz
AFC Off-Tune R73 To 35.05 MHz
OK?
NO
Check 9 Turn Coil,
Q3, CR8, Voltage Divider
Network and Solder Splashes
With 45.75 MHz Injected At P1
In Open Loop Set Signal For IV
At 20 dBmV Input Using R7 and Set
DC Level For .1 V Using R27
OK?
NO
Wrong DC Level
IC3, IC5, R17, R24
R27,R26, and R28
No 45.75 MHz Signal
Check 3rd L.O., FL1 IC1, IC2
IC3, IC5, L3, L5, L6, and S1


YES
AFC Curves At Pin 1 of IC9 Using Pink Slug For Max. Amp. and Blue Slug For A Symmetrical Waveform
Check AFC Coils, IC9, Q2, CR7, CR6, and Solder Splashes Signal Should Be 11 Times Greater At Pin 1 Than Pin 3 of IC9
NO
OK?
YES
Inject 10.7 MHz At Pin 1 of IC2 Tune 2nd and 3rd LC Network For 10.7 MHz Using Disc Caps At C15 and C18
Check IC2, IC3, R12 L5, L6, C14, R15, IC5 And Solder Splshes
NO
OK?
YES
Inject 45.75 MHz At P1 In Open Loop Waveshape Signal Using Disc. Cap At C4 Signal Should Be Flat or Haystacked On Top
Check FL1, R5, L3, C5, 3rd L.O., MX1, and IC1 Solder Splashes
NO
OK?


YES
Set Intergrator At Pin 4
Of IC3 for .4 V DC Level
Using R25 in Closed Loop
Check IC3, IC6,
Voltage Divider Network
Solder Splashes
NO
OK?
YES
Meter Tracking Should Read
20 dBmV at 20 dBmV and
±.5 dBmV on the End Points
Check IC10, R83, R85,
R82, and R87
Solder Splashes
NO
OK?
YES
Peak Detector Signal Should
Peak Up Within .25 dBmV and
No Higher Than .1 dBmV
Check
IC4, R19, and C21,
Solder Splashes
Ground-C23
NO
OK?
YES
Hum
Should Read 2% and
4% Modulation ±.25%
Check
CR4,CR5, IC9,and
Solder Splashes
NO
OK?


YES
Make Sure-Can Isn't Shorted
On Coil Check Q5, CR11, L11,
Solder Splashes
Set Internal Calibrator
At J10 for 150 MHz
NO
OK?
Final Inspection
Completed

SAM III INTROUCTION

The model Sam III is the first in a new generation of completely microprocessor-controlled signal level meters. Utilizing state-of-the-art electronic tuning, coupled with on-board computer memory, the Sam III allows rapid keyboard access to any frequency or channel across the entire CATV spectrum. All standard channels and HRC channels in the 450 MHz CATV band have been preprogrammed for the operator. These channels may be called up in any order, simply by selecting the channel designation (2-60), and then the format (either standard channel or HRC). With only three keystrokes, any channel across the band may be tuned. With one additional switch, the audio of that channel may be selected. In addition to the preprogrammed channels within the memory, the Sam III is also programmed to select any frequency within .1 MHz across the band, simply by pushing the correct keys for the frequency and then pressing the FREQ key. This allows any frequency across the band to be selected, whether or not it is a standard or HRC channel.

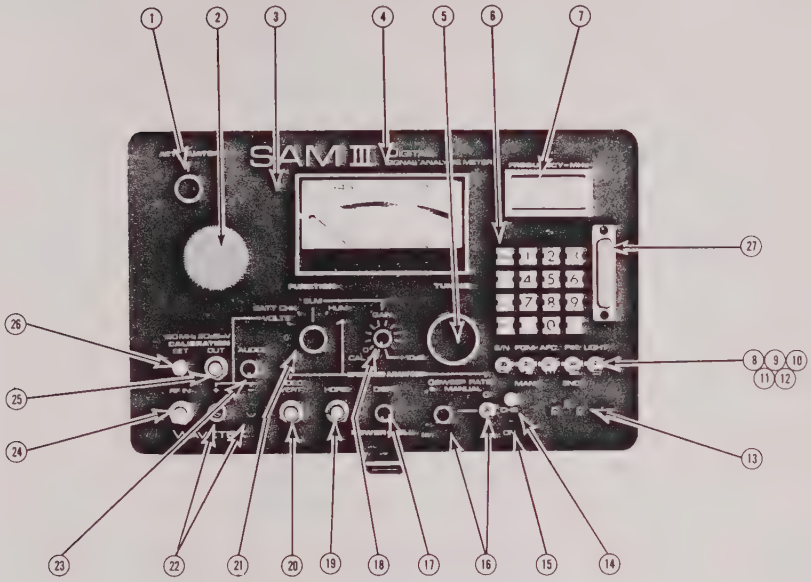
All Sam III's are 450 MHz units. They are also available in the UHF range. This is not a UHF to VHF converter or adapter: the Sam III becomes a UHF receiver when this mode is selected. The same input connector and attenuator is used for both bands.

SAM IIID INTRODUCTION

The Sam IIID is a computer controlled version of the Sam III. The Sam IIID utilizes the advanced microprocessor techniques that are is also empolyed in the Sam III. Access to the Sam IIID may be through telephone lines equipped with the correct modems, or through two-way cable systems, equipped with the proper interface. Remote frequency and channel selection is accomplished in the same manner as from the keyboard, except that the programming device is connected to the instrument via an RS-232 interface. Provisions are made for remote measurements of signal level, hum, battery status, and temperature, in addition to automatic power on/off of the unit. All standard channels and HRC channels in the 450 MHz CATV band have been preprogrammed for the operator. This programming includes both the video carrier and the audio carrier for all of the channels.

All Sam IIID's are 450 MHz units. They are also available in the UHF range. Like the VHF band, the UHF band may be selected remotely, through the RS-232 interface, and accessed for remote and/or automated testing.

SAM III AND SAM IIID FRONT PANEL



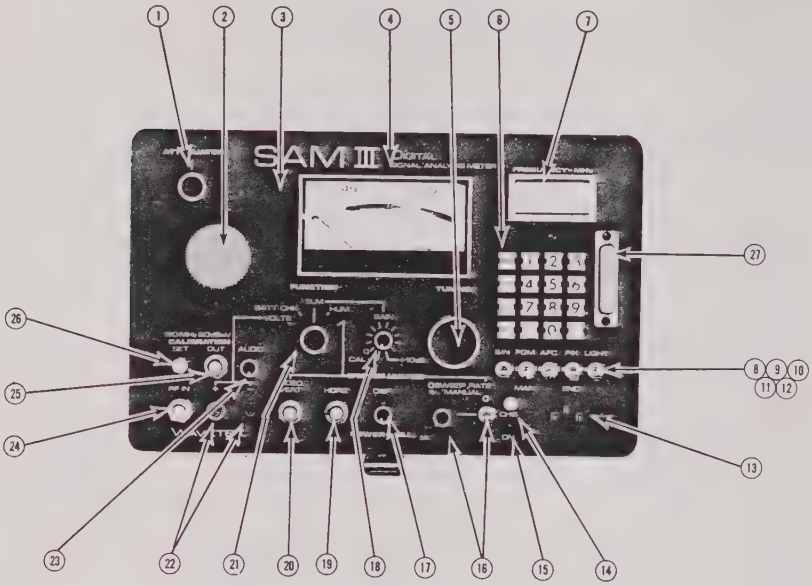
ITEM	DESCRIPTION	PART NUMBER
1	Attenuator Knob	2410-01-0039
2	Speaker Grill	1410-01-1960
3	UHF/VHF Optional Switch	5106-00-0022
4	Meter Bezel	2410-08-0010
5	Course Tune Knob	2410-01-0042
6	Keyboard	5108-00-0003
7	LCD Display	2410-03-0006
8	Light Switch	5106-00-0021
9	PIX/SND Switch	5106-00-0022
10	AFC Switch	5106-00-0021
11	PRG/MAN Switch	5106-00-0025
12	Signal to Noise Switch	5106-00-0020
13	AC Recpetical	2112-32-0006
14	Charge Light	2410-02-0007
15	On LED	4810-02-0007
16	a) Sweep Rate/Manual Switch	4610-40-4106
	b) Sweep Rate/Manual Knob	2410-01-0040
17	DISP/Power Knob	2410-01-0035
18	Gain Knob	2410-01-0035
19	Horizontal Connector	2110-06-1005
20	Video/Vertical Connector	2110-06-1005
21	Function Switch Knob	2410-01-0039
22	Banana Jack a) Positive	2112-01-0005
	b) Negative	2112-01-0006
23	Audio Knob	2410-01-0034
24	RF In Connector	2110-00-0001
25	Calibration Out Connector	2110-06-1005
26	Calibration Set Control	4610-14-8253
27	Remote Connector	2112-04-0005

SPECIFICATIONS FOR MODEL SAM III & IIID

SIZE	7" high x 11" wide x 10" deep
WEIGHT	11 lbs.
BATTERY	Rechargeable Nickle Cadmium Typically have 8 hours, continuous operation.
AC POWER REQUIREMENTS Charging only	110 VAC ± 10% (220 VAC ± 10% optional); 50 to 60 Hz; 20 W
AMPLITUDE RANGE	-40 to +60 dBmV
AMPLITUDE ACCURACY	± .5 dB
TEMPERATURE RANGE	0 to 120° F
TEMPERATURE ACCURACY	± 1 dB
FREQUENCY RANGES	4 to 450 MHz 470 to 890 MHz
SELECTIVITY	Sufficient to distinguish between two FM signals of equal amplitude 400 kHz apart. Sufficient to measure an audio carrier in the presence of an upper channel video carrier 40 dB greater in amplitude.
I.F. BANDWIDTH	280 kHz at 3 dB, 600 kHz at 40 dB point
HUM	0.5% to 5%
CALIBRATOR	
Frequency	150 MHz ±2 MHz
Amplitude	+20 dBmV ±.25 dB over temperature range
VOLTMETER	5 - 100 AC-DC 10%
SPECTRUM ANALYZER	
Amplitude Range	40 dB on screen; -40 dBmV to +60 dBmV
Frequency Range	4 MHz to 300 MHz or 4 MHz to 450 MHz
Rate	Variable 2 Hz to 40 Hz, plus manual.
Dispersion	Variable from .15 MHz
Horizontal	+.5 to +9V
Vertical	0-3V
S/N	@63 MHz ± 1 dB from 21.6 dB (factory spec)
PEAK DETECTOR	-.2 dB
AFC	Must pull up from at least 5 dB down -.5 dBmV

KEYBOARD PROGRAMMING	
Standard Channels	VHF:Video 2 to 60 Audio 2 to 60 UHF:14 to 83
HRC Channels	Video 2 to 60 Audio 2 to 60
Frequency	Preset for 0.1 MHz steps, 4 MHz to 450 MHz, 470 to 890 MHz.

OPERATOR CONTROLS FOR MODEL SAM III AND SAM IIID



1	ATTENUATOR CONTROL	selects the RF input level range and meter scale to be read.
2	SPEAKER	gives audio output of demodulated signal.
3	U/V SWITCH	selects UHF or VHF frequency range when UHF option is installed.
4	METER	indicates value of function being measured.
5	TUNING CONTROL	manually selects the frequency to be measured when the PGM/MAN switch is set to MAN.
6	KEYBOARD	selects the frequency or channel to be measured when the PGM/MAN switch is set to PGM.
7	FREQUENCY DISPLAY	indicates the frequency selected via the keyboard or tuning control. (4 digits)
8	S/N SWITCH	enables internal compensation for 4 MHz bandwidth noise measurements.
9	PGM/MAN SWITCH	enables either the keyboard or tuning control.
10	AFC SWITCH	enables the internal AFC circuit.
11	PIX/SND SWITCH	selects the video or audio carrier for measurement when a channel is programmed via the keyboard.
12	LIGHT SWITCH	provides backlighting for the meter.

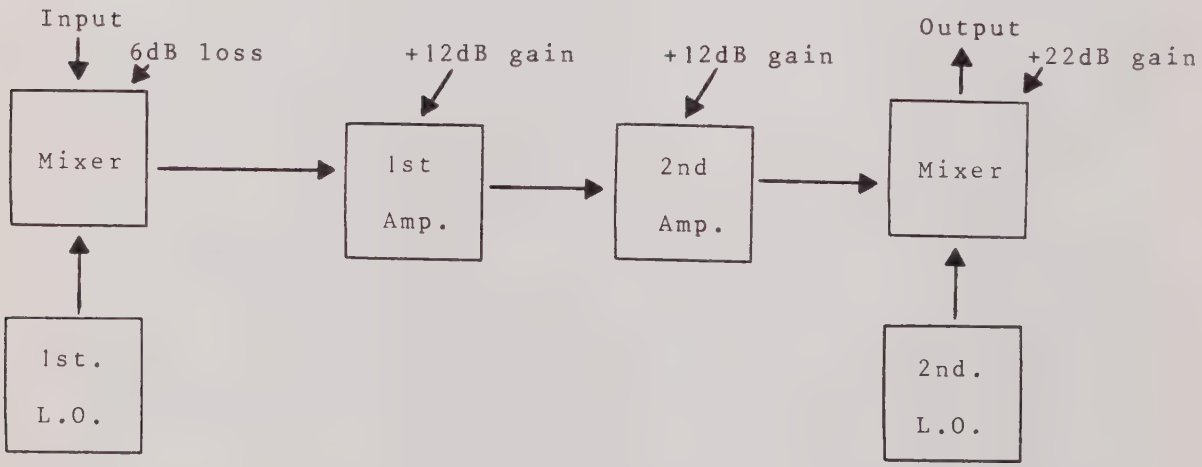
13	AC LINE CONNECTOR	provides connection to AC mains via three-conductor line cord.
14	CHARGE LAMP	indicates the internal battery is being charged.
15	ON LAMP	indicates operation of the instrument
16	SWEEP RATE/MANUAL	this switch selects between sweep and manual modes of the spectrum analyzer. The control selects the analyzer sweep or manual rate.
17	DISP/POWER CONTROL	applies DC power to the instrument when pulled out, and selects the spectrum analyzer dispersion.
18	GAIN CONTROL	provides 0 to 10 dB of level adjustment when the function switch is set to SLM (signal level meter mode).
19	HORIZ. CONNECTOR	provides the analyzer horizontal output for an oscilloscope.
20	VIDEO/VERT CONNECTOR	provides connection for the video output signal and the analyzer vertical output for an oscilloscope.
21	FUNCTION SWITCH	selects the function to be measured.
22	+/- CONNECTORS	accept test leads for voltage measurements when the function switch is set to volts.
23	AUDIO CONTROL	enables the internal audio circuit and adjusts the volume of the speaker output.
24	RF IN CONNECTOR	provides input for the signal to be measured.
25	CALIBRATION OUT CONNECTOR	provides output from the internal calibration to calibrate the meter for amplitude measurements.
26	CALIBRATION SET CONTROL	calibrates the meter for amplitude measurements.
27	REMOTE CONNECTOR	25 pin D-type provides RS-232 interface connection for remote selection of frequency or channel.

NOTE:
THIS CONNECTOR IS ONLY ON MODEL SAM IIID

R F ASSEMBLY

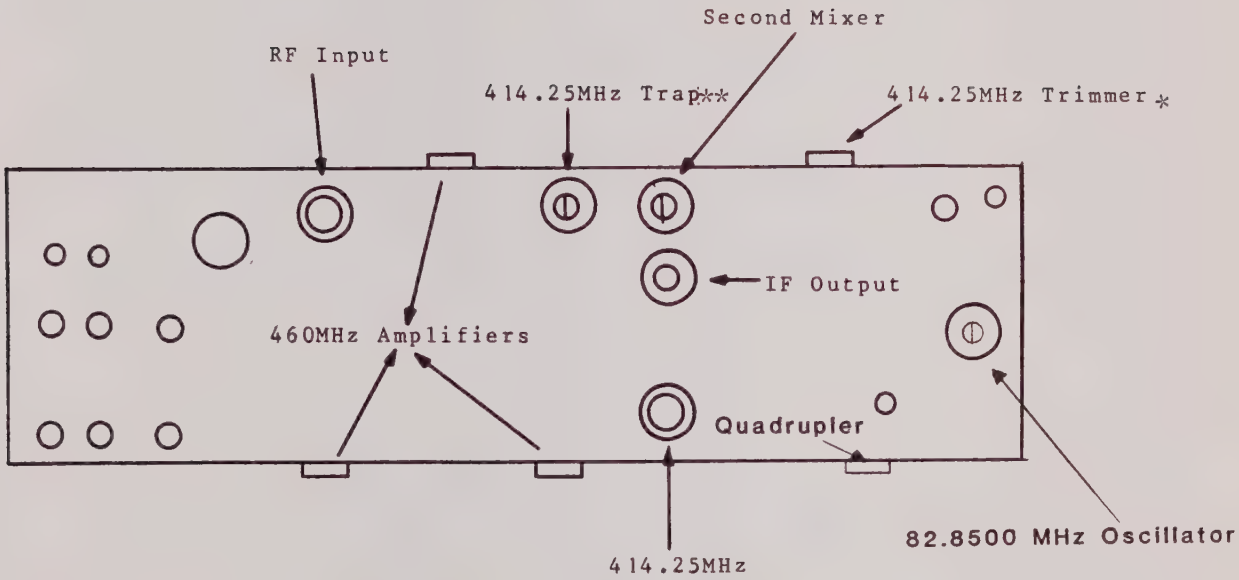
The R.F. assembly is a frequency converter which converts all tuning ranges of the SAM to a common output of 45.75MHz. The R.F. consists of a 1st L.O. which uses varactor tuning to feed the mixer with the incoming signal. The output of the mixer is 460MHz. Two stages of I.F. amplification follow the mixer with about +12 dB of gain each. This amplified 460MHz signal is then fed to another mixer circuit which is coupled to the 2nd L.O. (414.25) for a common output frequency of 45.75MHz and is connected to the input of the main board I.F.

Some units have UHF coverage by using a added UHF tuning board (1st L.O.). Also, the 2nd L.O. may be crystal controlled, rather than the standard tuneable oscillator.



R.F ASSEMBLY

RF Assembly



* On Sam I's without crystal oscillator, this trimmer is the frequency adjustment, and the 82.500 MHz oscillator and quadruplertrimmers are aluminated.

** This trimmer is used to adjust a 414.25MHz trap. This trap keeps the 2nd L.O. signal from feeding back into the IF which could cause a spur to occur at 414.25MHz. Only adjust this trimmer if the Sam indicates a signal at 414.25MHz, when no signal is applied to the Sam RF in" on the front panel.

RF SPECIFICATIONS

TYPE	GAIN	SWEEP WIDTH
Jr. 300	+36 dB - +40 dB	-12 - 310 MHz
Jr. 400	+36 dB - +40 dB	-12 - 410 MHz
Jr. 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
Jr. 450	+36 dB - +40 dB	-12 - 460 MHz
I 300	+36 dB - +40 dB	-12 - 310 MHz
I 400	+36 dB - +40 dB	-12 - 410 MHz
I450	+36 dB - +40 dB	-12 - 460 MHz
I 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
I 450 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
II 300	+36 dB - +40 dB	-12 - 310 MHz
II 400	+36 dB - +40 dB	-12 - 410 MHz
II 450	+36 dB - +40 dB	-12 - 460 MHz
II 300	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
III 450	+36 dB - +40 dB	-12 - 460 MHz
III UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
IV 450	+36dB - +40 dB	-12 - 460 MHz
IV UHF	VHF +36dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz

NOTE

All of these RF specifications will include units with the analyzer option.

RF TROUBLESHOOTING

Before taking voltage readings in the RF itself, be sure proper voltages are being supplied to the RF.

There is 12 V supplied to the oscillator board along with varactor drive 0 to 12 volts for tuning.

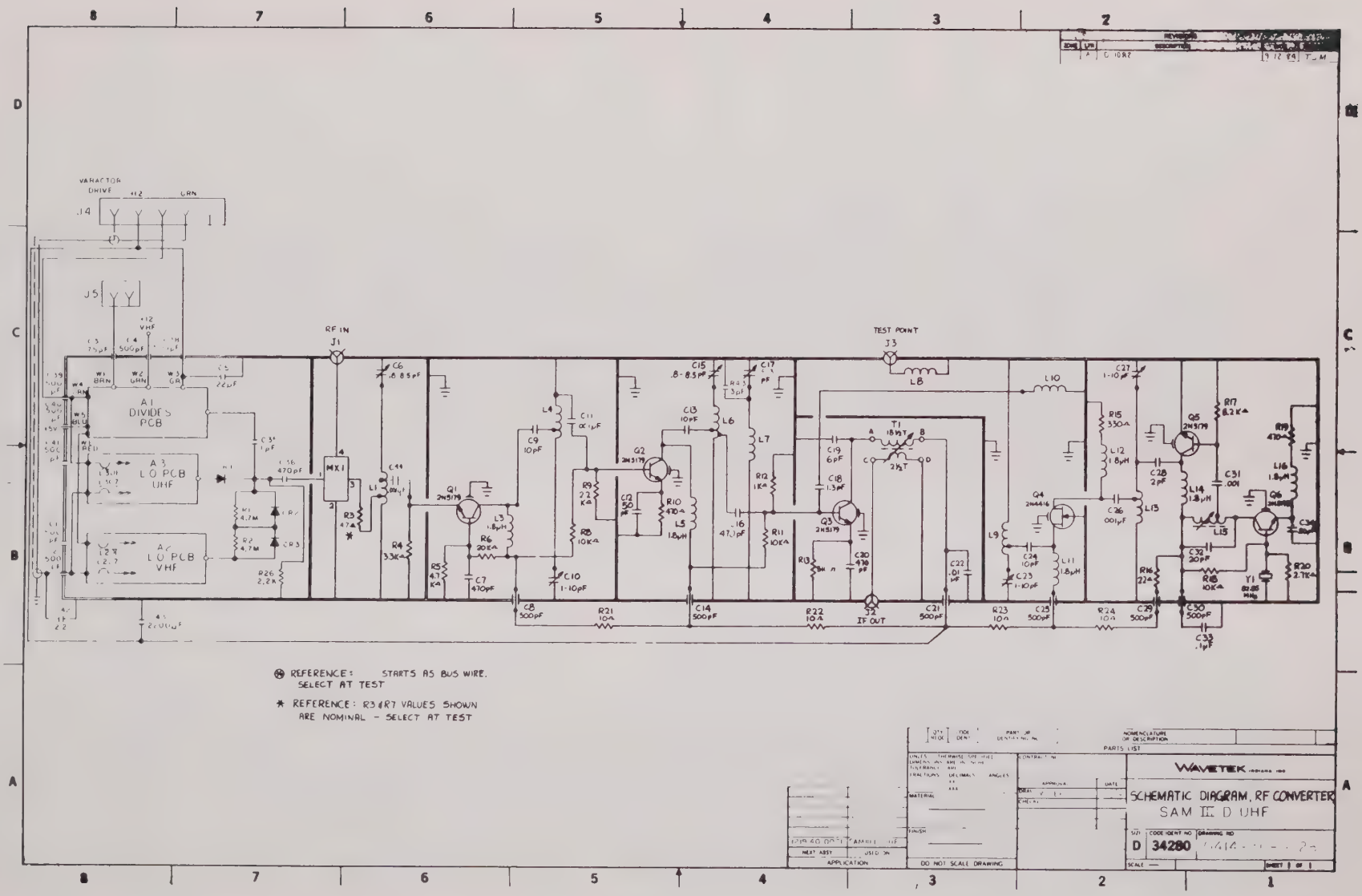
The first IF amp. transistor is a 5179 and should read approximately 1.6 volts on the emitter, 2.4 volts on the base, and 12 volts on the collector.

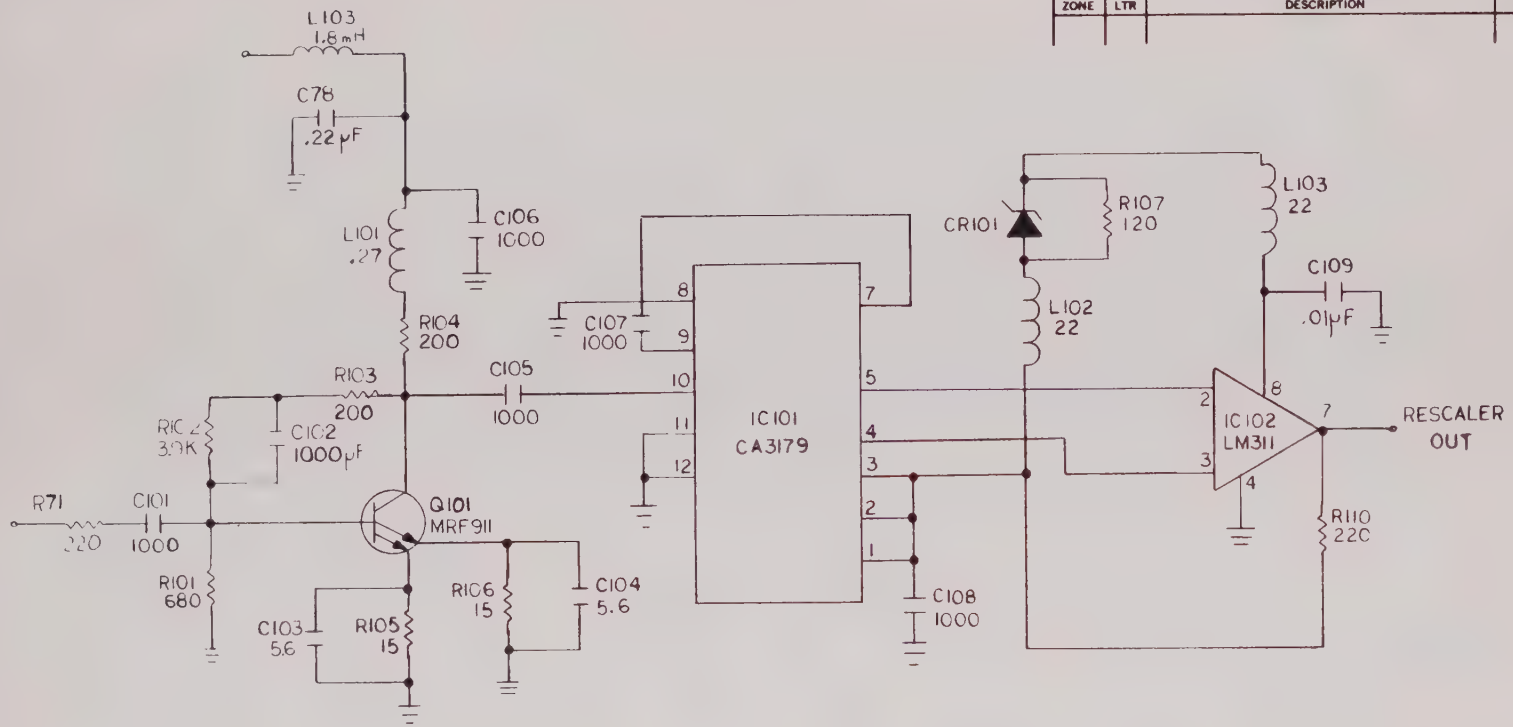
The second IF amp. transistor is also a 5179 which is coupled to the first amp. stage by its base and should read 2.2 colts, 1.3 volts for the emitter and 12 volts for the collector.

In the output mixer stage, a 5179 transistor is used. There should be 1.07 volts on the base which is connected to the 2nd amp. stage by a 470 pf. cap. The emitter should read .3 to .7 volts. The collector is supplied by 12 volts.

The second L.O. (not crystal controlled) uses a 4416 transistor. There should be 12 volts on the collector and 1.5 volts on the base.

If all voltages in the RF are correct, but still does not meet gain, sweep, or flatness specs, the SAM should be returned.


VARACTOR DRIVE
+12
GRN
J4
J5
+12 VHF
A1 DIVIDES PCB
A3 LO PCB UHF
A2 LO PCB VHF
RF IN
J1
MX1
TEST POINT
J3
LB
IF OUT
J2
T1
Y1
REFERENCE: STARTS AS BUS WIRE. SELECT AT TEST
REFERENCE: R3 & R7 VALUES SHOWN ARE NOMINAL - SELECT AT TEST
WAVETEK
SCHEMATIC DIAGRAM, RF CONVERTER
SAM II D UHF
34280
DO NOT SCALE DRAWING



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± .XX ± ±
.XXX ±

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN TJM	6-17
CHECKED	

WAVETEK INDIANA, INC.

SAM III
DIVIDE BY 256

SIZE	CODE IDENT NO.	DRAWING NO.
B	34280	

SCALE | SHEET OF

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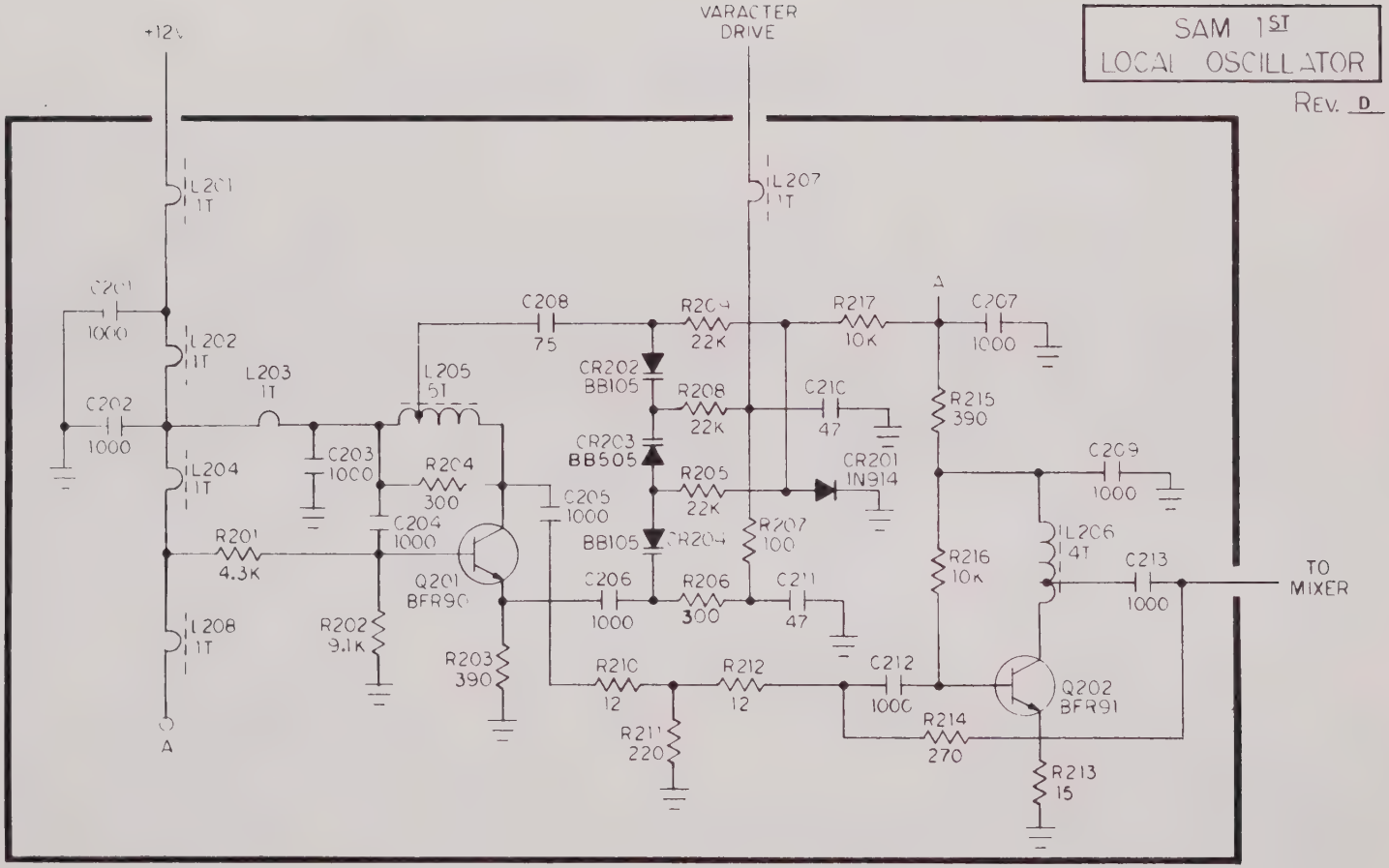
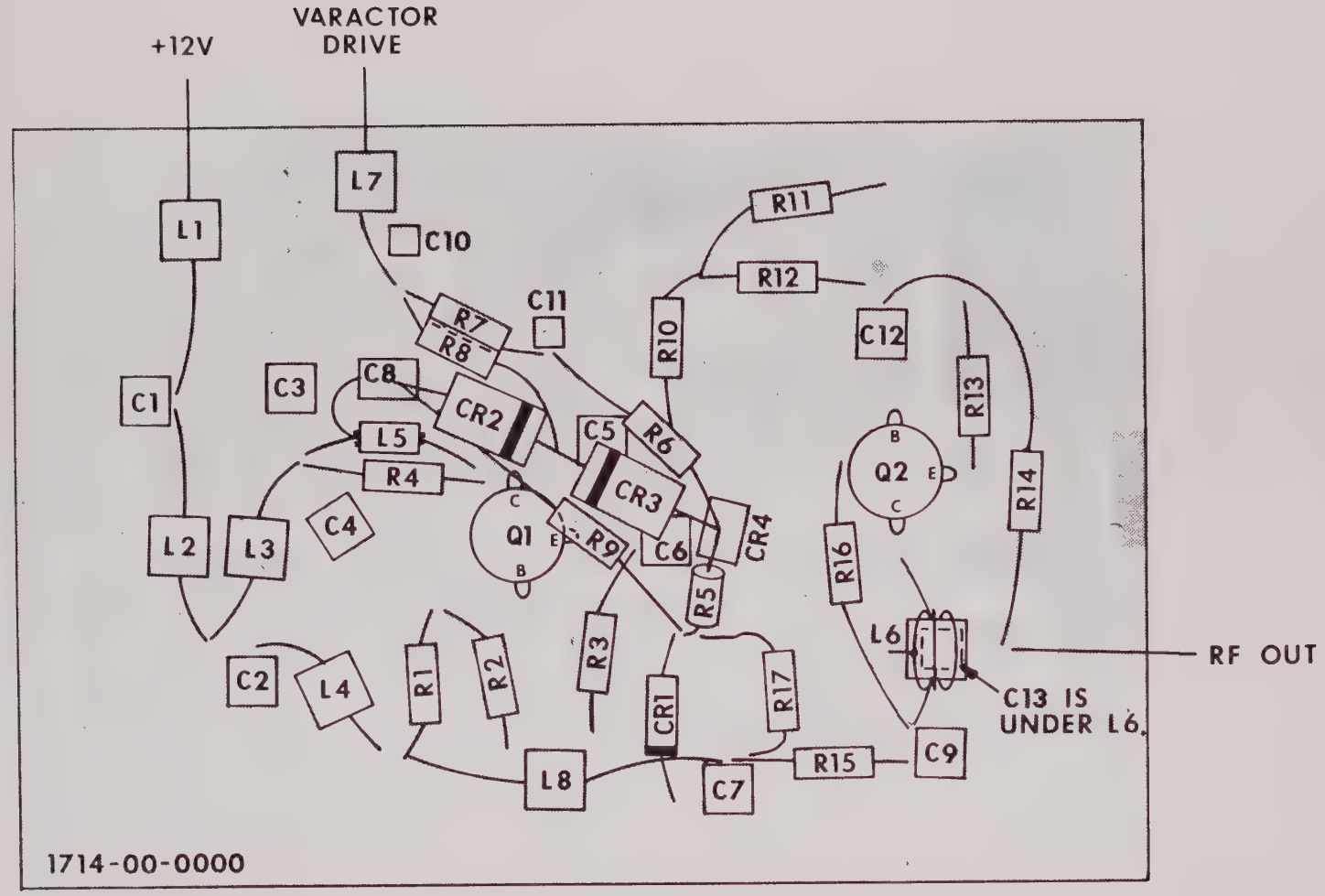
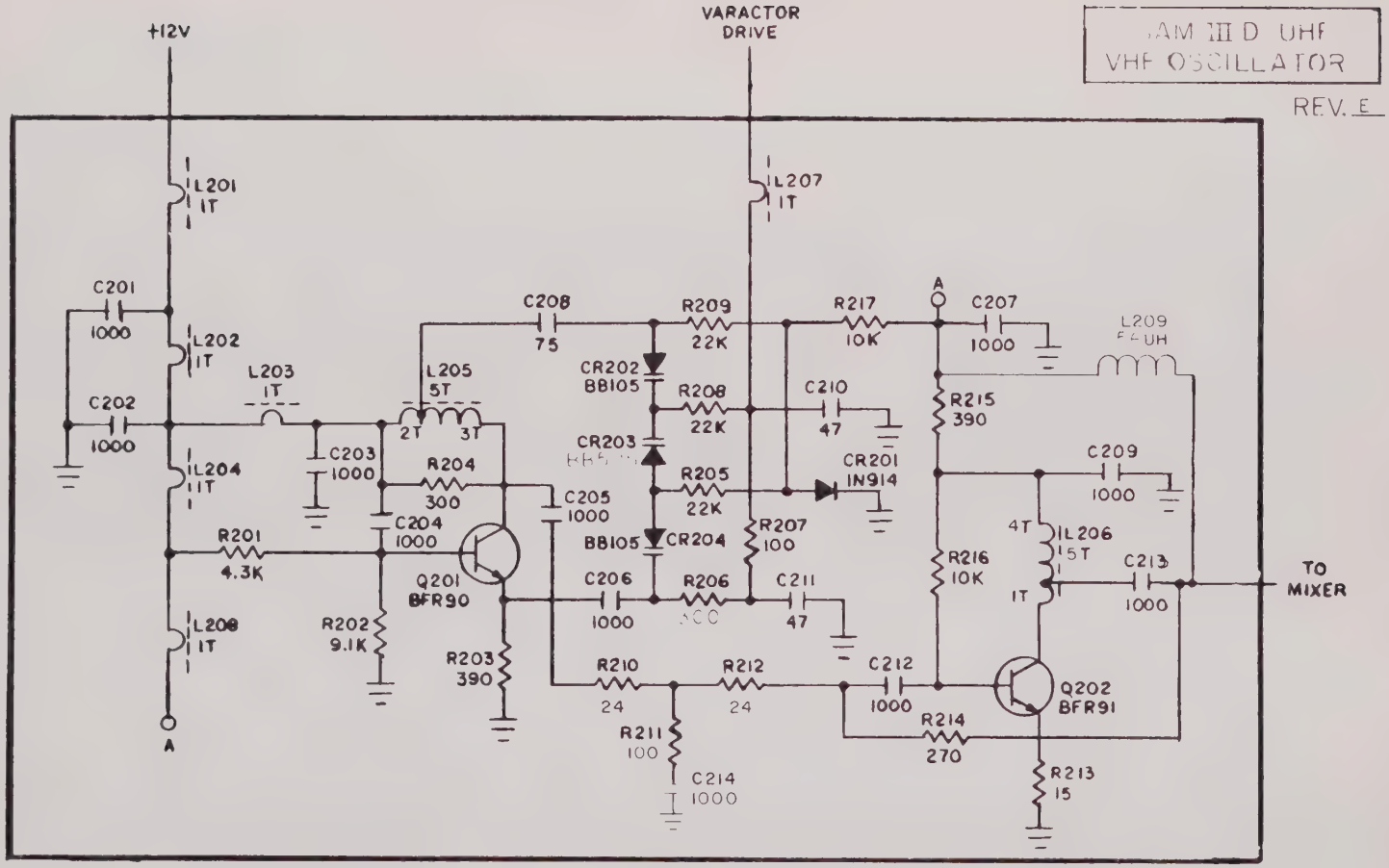
TELEDYNE POST N28549

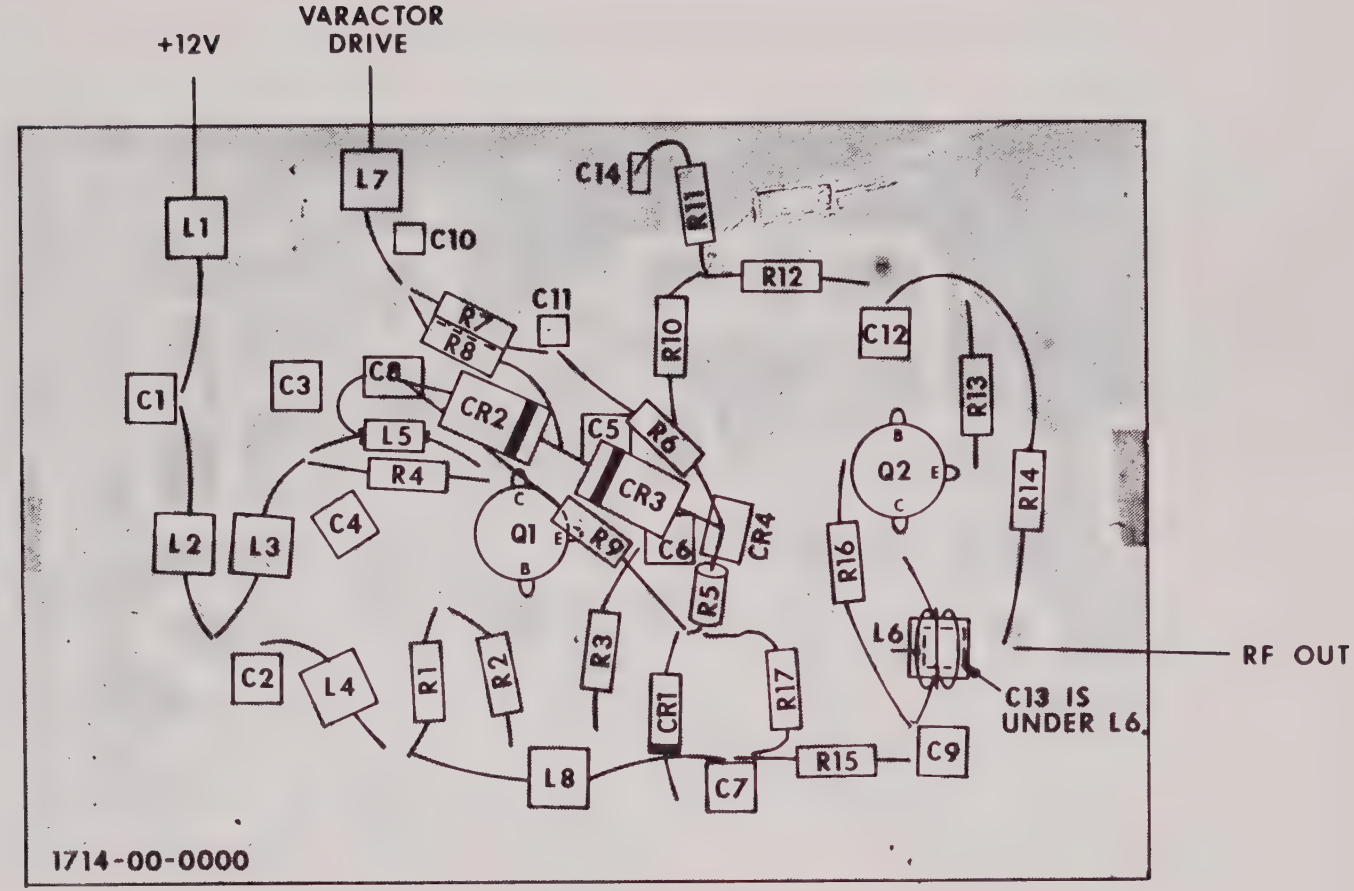
4-13


SAM 1ST
LOCAL OSCILLATOR
REV. D
+12V
VARACTER DRIVE
L201 1T
L207 1T
C201 1000
L202 1T
L203 1T
L205 5T
C208 75
R209 22K
R217 10K
C207 1000
A
C202 1000
L204 1T
C203 1000
R204 300
C205 1000
CR202 BB105
R208 22K
C210 47
R215 390
CR203 BB505
R205 22K
CR201 1N914
C209 1000
C204 1000
CR204 BB105
R207 100
L206 4T
R201 4.3K
Q201 BFR90
C206 1000
R206 300
C211 47
R216 10K
C213 1000
TO MIXER
L208 1T
R202 9.1K
R203 390
R210 12
R212 12
C212 1000
Q202 BFR91
R211 220
R214 270
R213 15
A

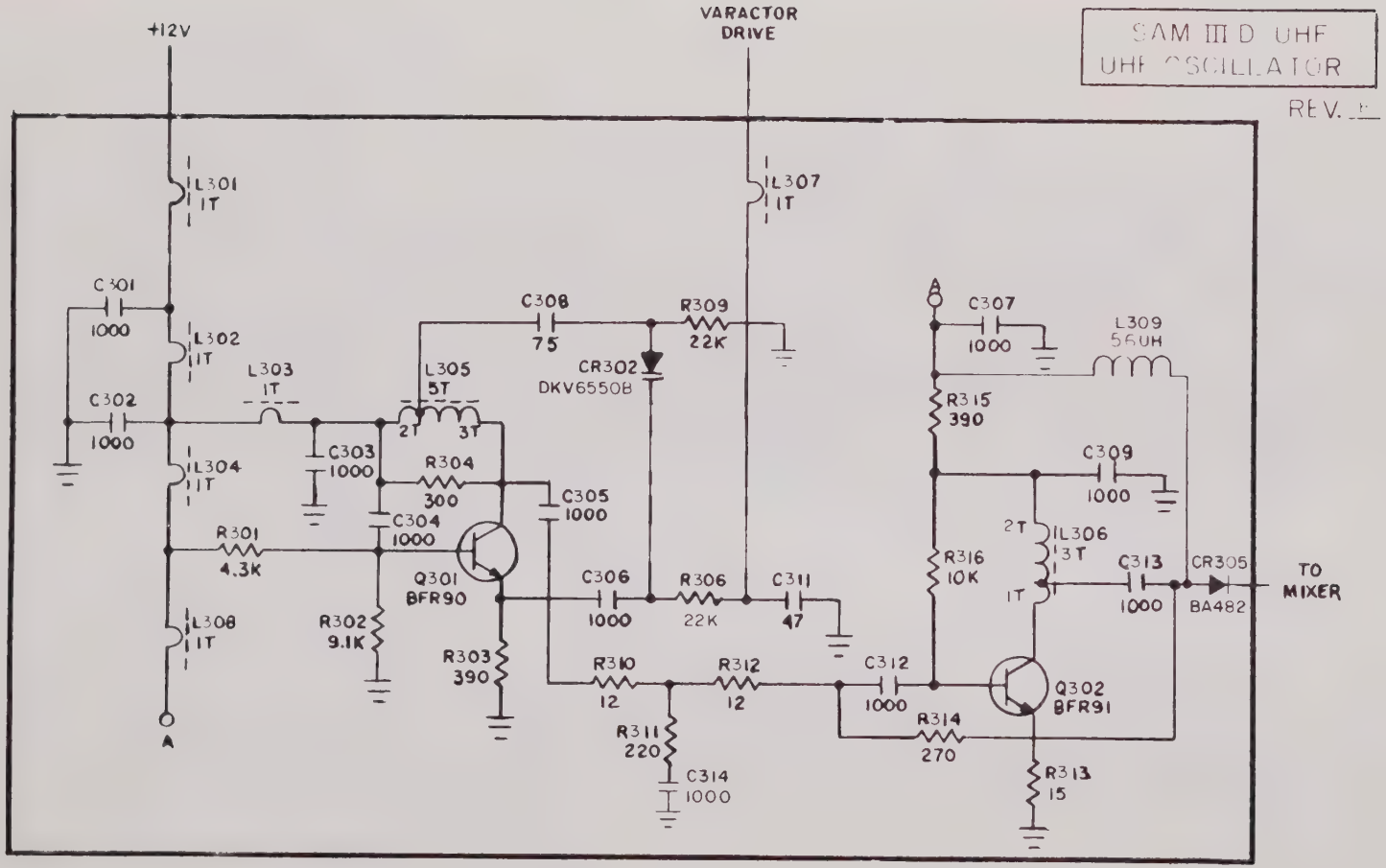


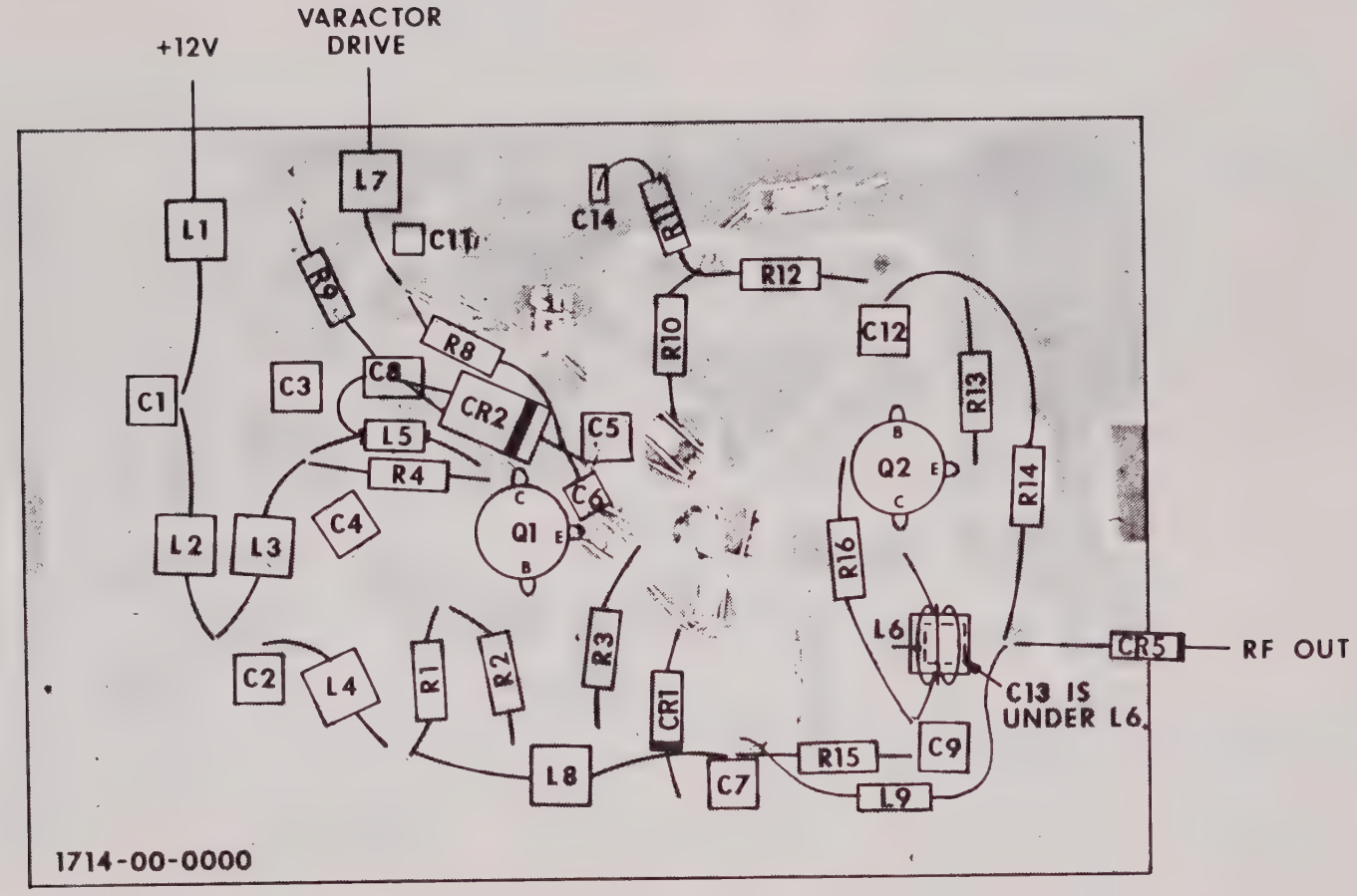
ALL REF. DES. ARE 200 SERIES


+12V
VARACTOR DRIVE
SAM III D UHF VHF OSCILLATOR
REV. E
L201 1T
L202 1T
L203 1T
L204 1T
L205 5T
2T
3T
L207 1T
L208 1T
C201 1000
C202 1000
C203 1000
C204 1000
C205 1000
C206 1000
C207 1000
C208 75
C209 1000
C210 47
C211 47
C212 1000
C213 1000
C214 1000
R201 4.3K
R202 9.1K
R203 390
R204 300
R205 22K
R206 SCO
R207 100
R208 22K
R209 22K
R210 24
R211 100
R212 24
R213 15
R214 270
R215 390
R216 10K
R217 10K
L209 .22UH
4T
L206 15T
1T
CR201 IN914
CR202 BB105
CR203
BB105
CR204
Q201 BFR90
Q202 BFR91
A
A
TO MIXER

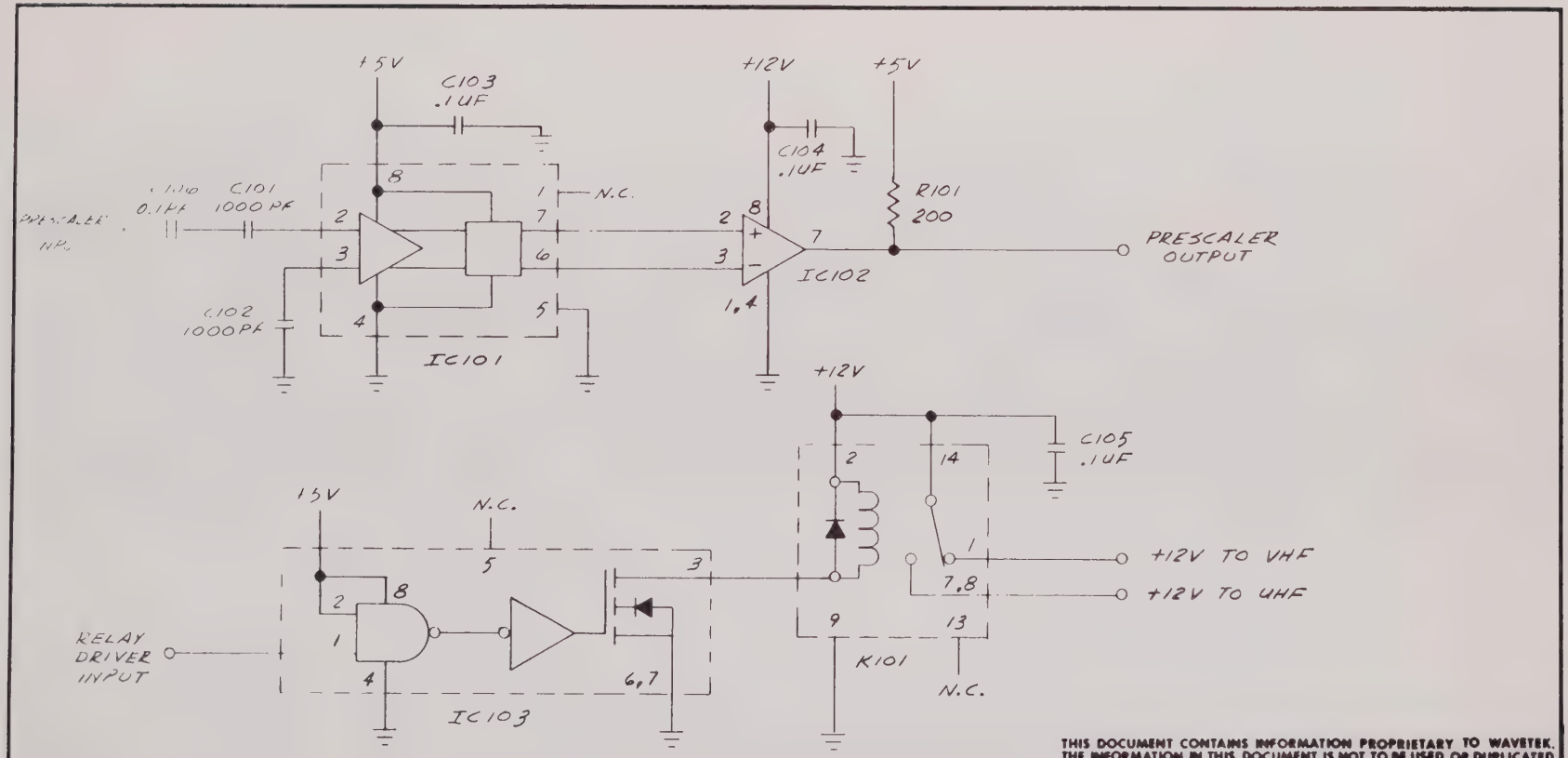


ALL REF. DES. ARE 200 SERIES


+12V
VARACTOR DRIVE
SAM III D UHF
UHF OSCILLATOR
REV. E
L301 1T
L307 1T
C301 1000
L302 1T
L303 1T
C302 1000
L304 1T
L305 5T
2T
3T
C303 1000
R304 300
C304 1000
C305 1000
R301 4.3K
Q301 BFR90
L308 1T
R302 9.1K
R303 390
A
C308 75
R309 22K
CR302 DKV6550B
C306 1000
R306 22K
C311 47
R310 12
R312 12
R311 220
C314 1000
C312 1000
R314 270
R313 15
Q302 BFR91
A
C307 1000
L309 560H
R315 390
C309 1000
2T
L306 3T
1T
R316 10K
C313 1000
CR305 BA482
TO MIXER



ALL REF. DES. ARE 200 SERIES



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TOLERANCE:
DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED

NO.	DESCRIPTION	BY
	REVISION	

MATERIAL: —

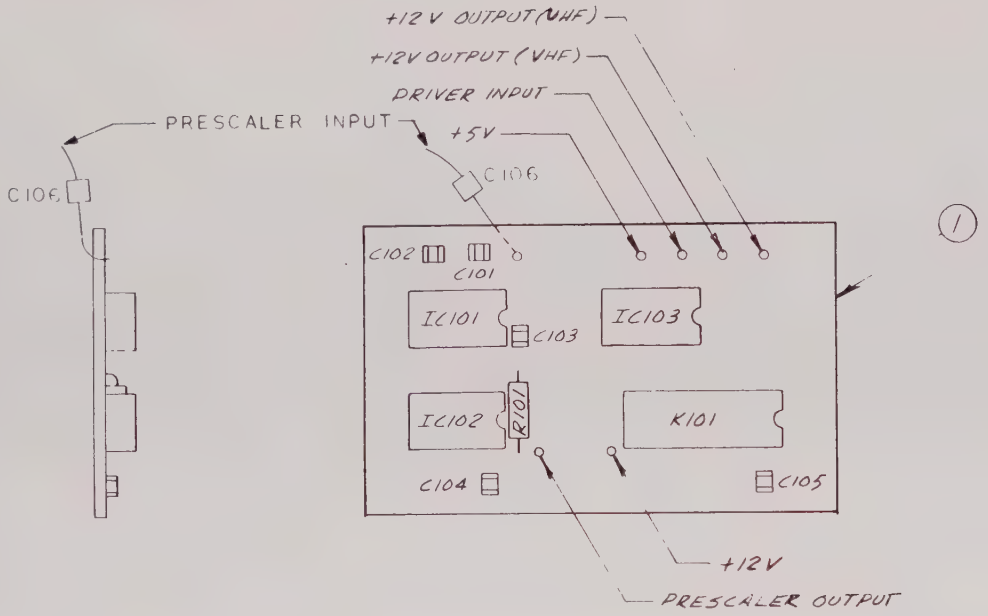
FINISH: —

ARTWORK # —

WAVETEK INDIANA

SCHEMATIC, PRESCALER PCB

DRAWN BY	SCALE	DATE
BRYNAN	—	1-28-83
CHK'D	DATE	DRAWING NO.
	2/14/83	0414-10-9013
RELEASED BY	DATE	



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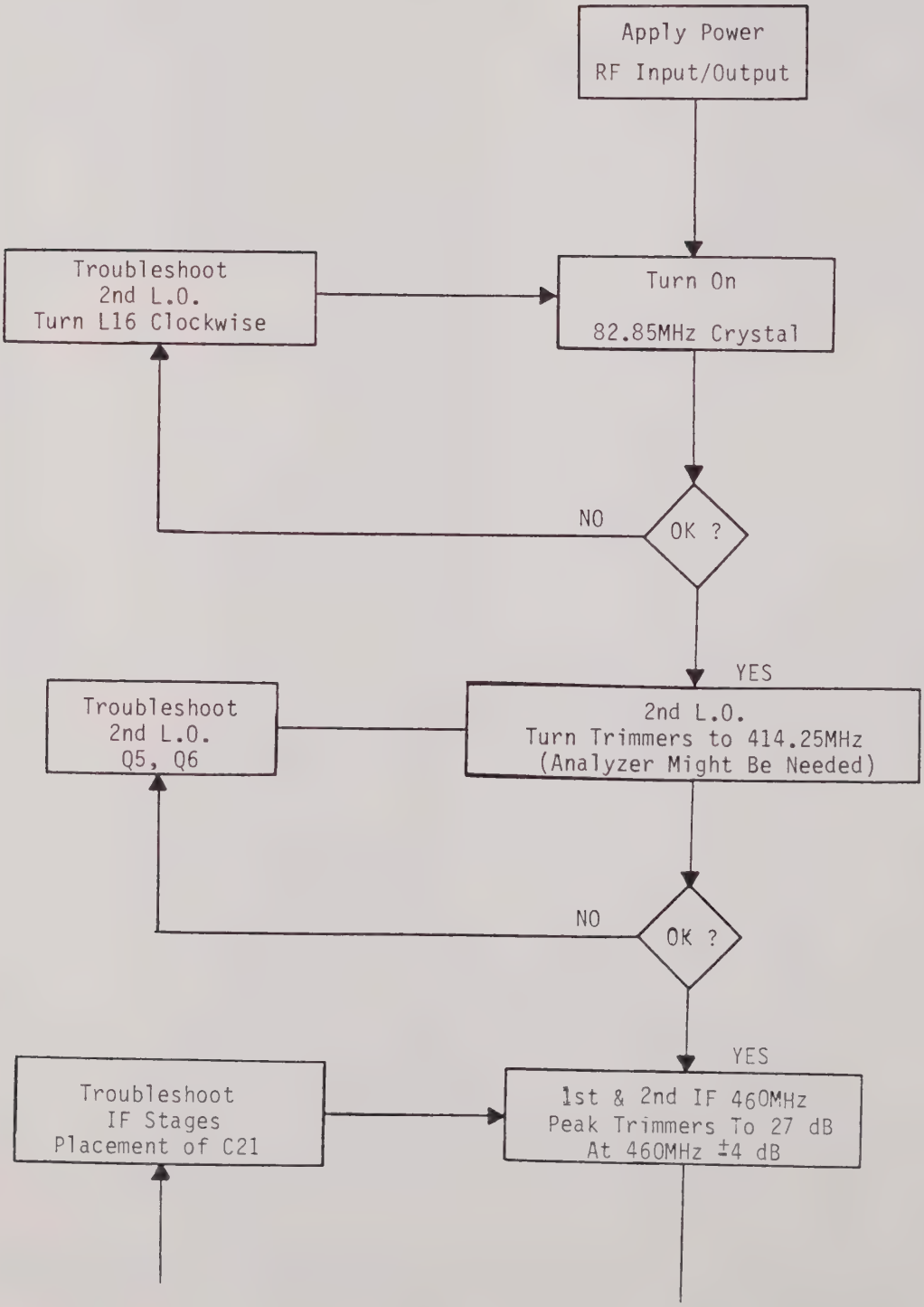
MATERIAL: SEE P/L 1218-40-9017	WAVETEK INDIANA		
	ASSY DWG, PRESCALER PCB		
FINISH:	DRAWN BY: BRYNAN	SCALE: 2X	DATE: 1-28-83
ARTWORK #	CHK'D: [illegible]	DATE: 2/14/83	DRAWING NO.: 0412-10-9025
	RELEASED BY	DATE	

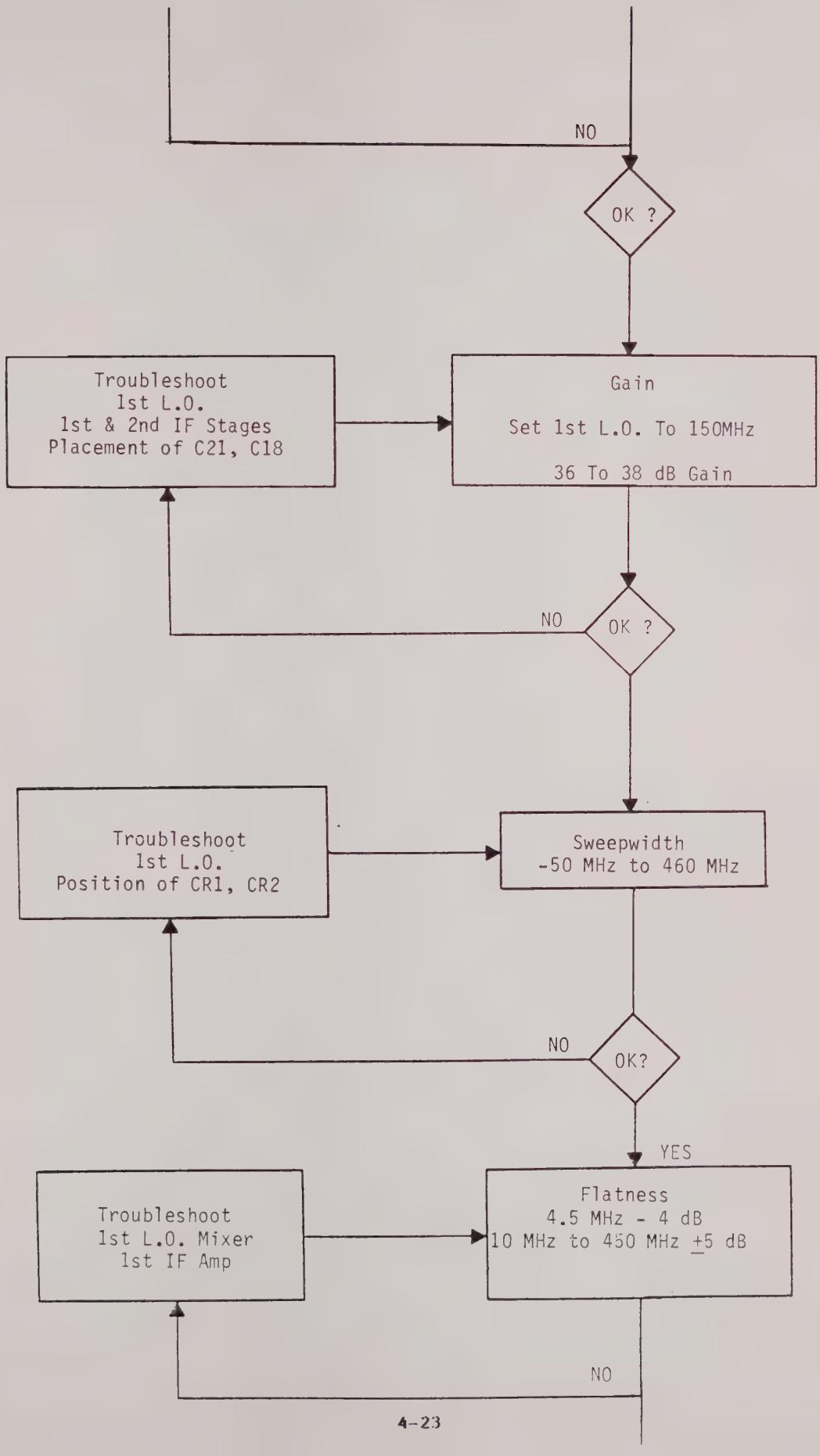
TOLERANCE:
DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED

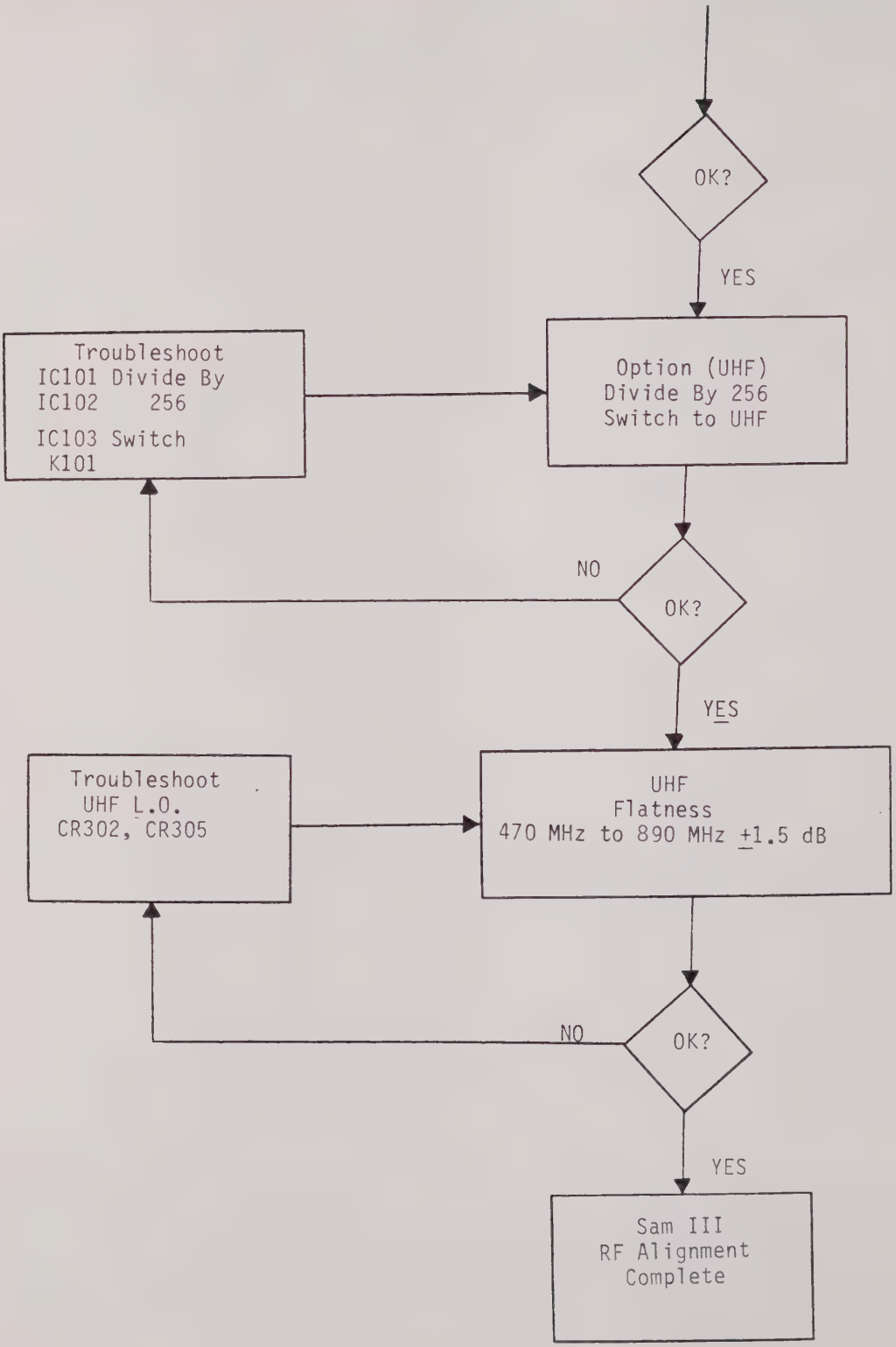
NO.	DESCRIPTION	BY
REVISION		

Sam III Head Alignment

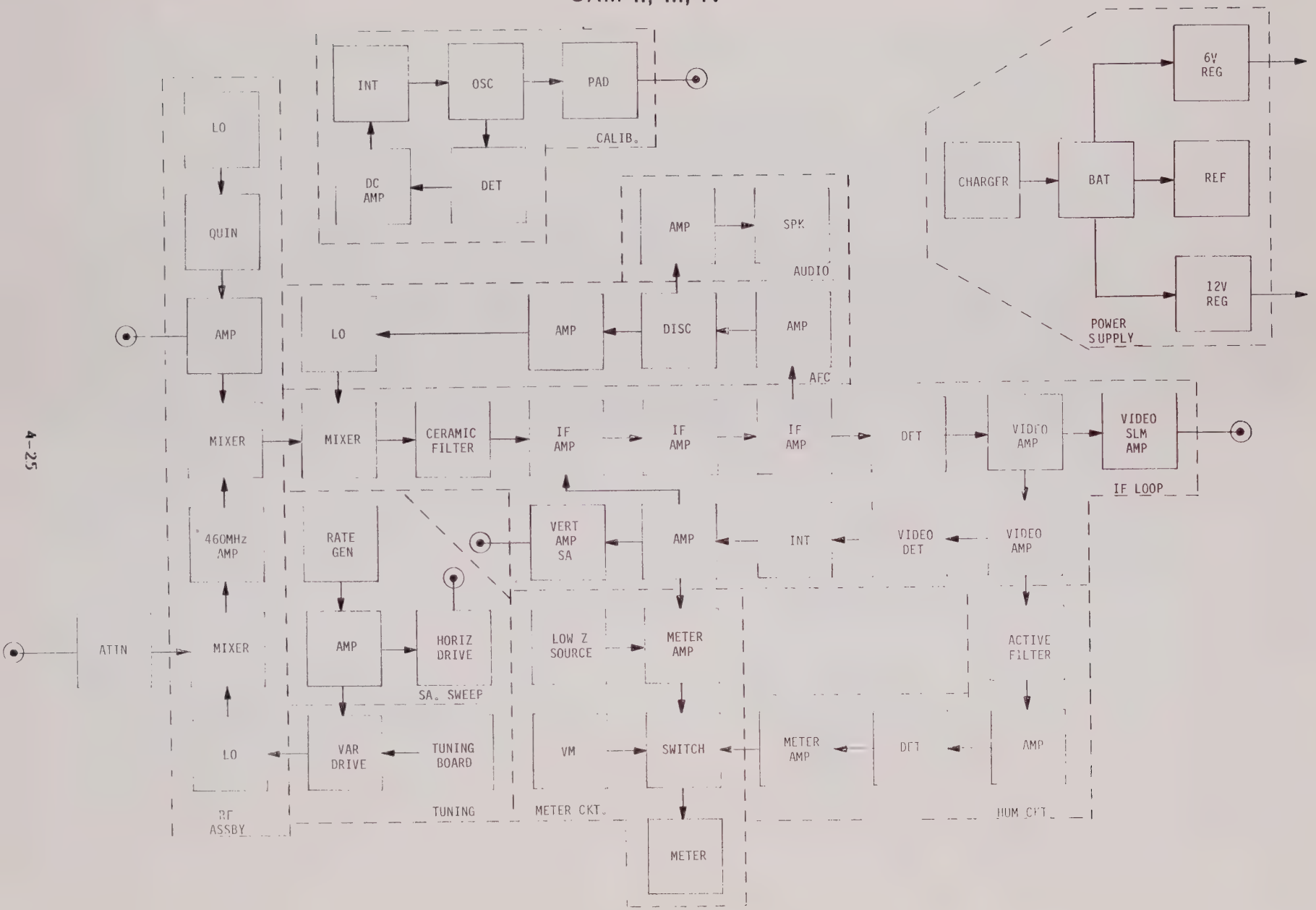
(Generalized)

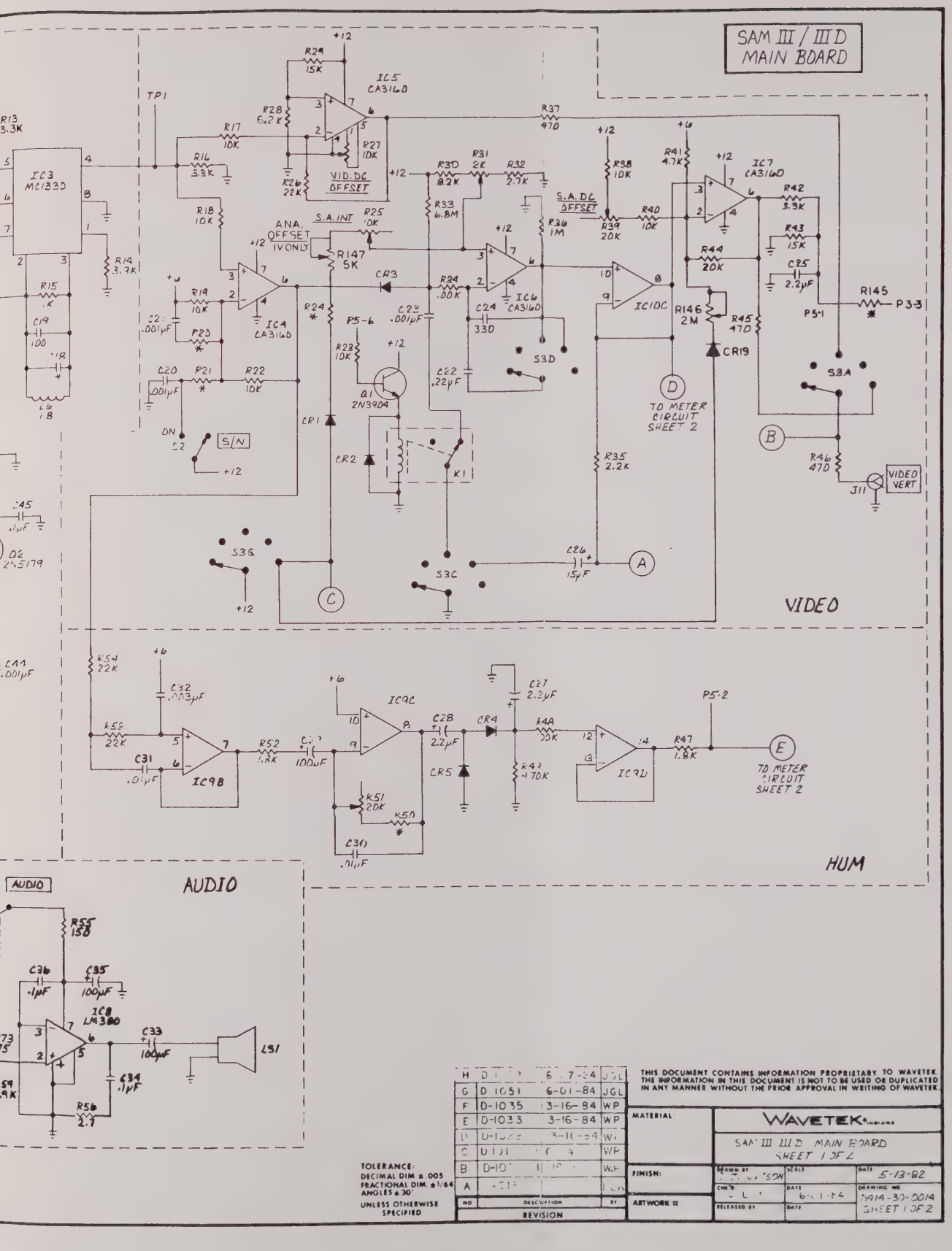



NO
OK ?
Troubleshoot
1st L.O.
1st & 2nd IF Stages
Placement of C21, C18
Gain
Set 1st L.O. To 150MHz
36 To 38 dB Gain
NO
OK ?
Troubleshoot
1st L.O.
Position of CR1, CR2
Sweepwidth
-50 MHz to 460 MHz
NO
OK?
YES
Troubleshoot
1st L.O. Mixer
1st IF Amp
Flatness
4.5 MHz - 4 dB
10 MHz to 450 MHz ±5 dB
NO


OK?
YES
Troubleshoot
IC101 Divide By
IC102 256
IC103 Switch
K101
Option (UHF)
Divide By 256
Switch to UHF
NO
OK?
YES
Troubleshoot
UHF L.O.
CR302, CR305
UHF
Flatness
470 MHz to 890 MHz ±1.5 dB
NO
OK?
YES
Sam III
RF Alignment
Complete

SAM II, III, IV


INT
OSC
PAD
CALIB.
DC AMP
DET
LO
QUIN
AMP
SPK
AUDIO
AMP
DISC
AMP
LO
AMP
AFC
6V REG
CHARGER
BAT
REF
12V REG
POWER SUPPLY
MIXER
MIXER
CERAMIC FILTER
IF AMP
IF AMP
IF AMP
DET
VIDEO AMP
VIDEO SLM AMP
IF LOOP
460MHz AMP
RATE GEN
VERT AMP SA
AMP
INT
VIDEO DET
VIDEO AMP
ATTN
MIXER
AMP
HORIZ DRIVE
SA. SWEEP
LOW Z SOURCE
METER AMP
ACTIVE FILTER
LO
VAR DRIVE
TUNING BOARD
VM
SWITCH
METER AMP
DET
AMP
RF ASSBY
TUNING
METER CKT.
HUM CKT.
METER



H	D [illegible]	6-[illegible]-84	JGL
G	D 1051	6-01-84	JGL
F	D-1035	3-16-84	WP
E	D-1033	3-16-84	WP
D	D-1032	3-16-84	WP
C	D 101	[illegible]	WP
B	D-10[illegible]	[illegible]	WP
A	-21[illegible]	[illegible]	[illegible]
NO	DESCRIPTION		BY

REVISION

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MATERIAL

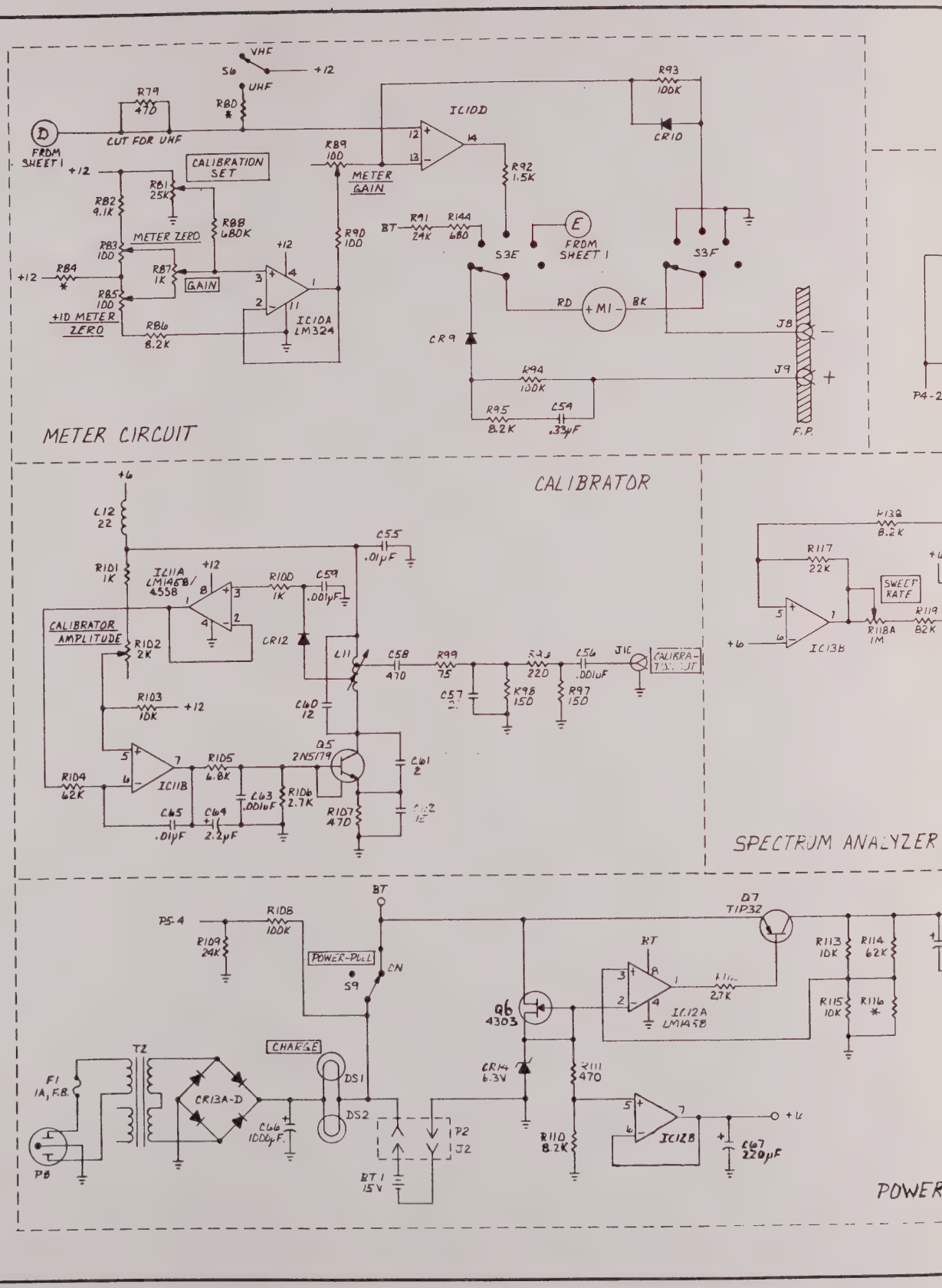
FINISH:

ARTWORK #

WAVETEK

SAM III IIID MAIN BOARD SHEET 1 OF 2

DRAWN BY [illegible] TSDW	SCALE	DATE 5-13-82
CHK'D [illegible]	DATE 6-1-84	DRAWING NO MAIA-30-0014 SHEET 1 OF 2
RELEASED BY	DATE	


METER CIRCUIT
CALIBRATOR
SPECTRUM ANALYZER
POWER
VHF
UHF
+12
R79 470
CUT FOR UHF
FROM SHEET 1
CALIBRATION SET
METER ZERO
GAIN
+10 METER ZERO
IC10A LM324
IC10D
METER GAIN
R93 100K
CR10
R92 1.5K
R91 24K
R144 680
S3E
S3F
FROM SHEET 1
+M1-
CR9
J8
J9
F.P.
R94 100K
R95 8.2K
C54 .33µF
CALIBRATOR AMPLITUDE
IC11A LM1468/4558
IC11B
CR12
L11
L12 22
C55 .01µF
C58 470
R99 75
R98 150
R97 150
C56 .001µF
J10
CALIBRATOR OUT
Q5 2N5179
C60 12
C61 2
C63 .001µF
C65 .01µF
C64 2.2µF
R103 10K
R104 62K
R105 6.8K
R106 2.7K
R107 470
R117 22K
SWEEP RATE
R118A 1M
R119 82K
IC13B
T2
F1 1A, F.B.
P8
CR13A-D
CHARGE
DS1
DS2
C66 1000µF
P2
J2
BT1 15V
P5-4
R108 100K
R109 24K
POWER-PULL
S9
ON
Q6 4303
IC12A LM148
IC12B
CR14 6.3V
R111 470
R110 8.2K
C67 220µF
Q7 TIP32
R113 10K
R114 62K
R115 10K
R116
P4-2

SAM III / III D
MAIN BOARD.

METER LIGHT

BT
LIGHT
S7
DS3
CR11
7V
DS4

VOLTS
BATT CHK
SLM
HUM
SPECTRUM ANALYZER
S3
FUNCTION

TUNING

+12
+6
C
IC13A LM324
R120 2.7K
MANUAL
R118 10K
R122 4.3K
R123 100K
R132 47K
R131 200K
SWEEP WIDTH
IC13C
C70 .47μF
S10
MAN
R125 10K
DISPERSION
R124 10K
IC13D
R126 100K
R128 150K
R129 10K
R130 10K
J7
HDR12
R127 220K

P4-7
PGM
S8B
MAN
R137 10K
R136 10K
TUNING
R143 10K
R135 4.7K
TP3
S3H
R134 10K
IC14 CA3160
R133 93K
S3B
C71 .15μF
NC
TO RF ASSEMBLY
P3

C68 2.2μF
C69 100μF
R142 1.5K
CR16
LN

TO MICROPROCESSOR BOARD
P4
1 LCD BACKLIGHT POWER
2 +6
3 +12
4
5
6
7 VAR DRIVE
8 TO PSM SBC
9 BATTERY
10
SBA
PGM
MAN
S11
PTX
SND
+6

TO MICROPROCESSOR BOARD
P5
1 VIDEO LEVEL SENSE
2 HUM SENSE
3 S.A. +12 V
4 BATTERY SENSE
5
6 HUM RELAY DRIVE

SUPPLY

H	D 1053	6-07-84	JGL
G	D 1051	6-01-84	JGL
F	D-1035	3-16-84	WP
E	D-1033	3-16-84	WP
D	D-1029	3-16-84	WP
C	D-1013	2-6-84	WP
B	ECN D-102	12-14-83	WP
A	D-018		D&R
NO	DESCRIPTION		BY

REVISION

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MATERIAL:
FINISH:
ARTWORK #:

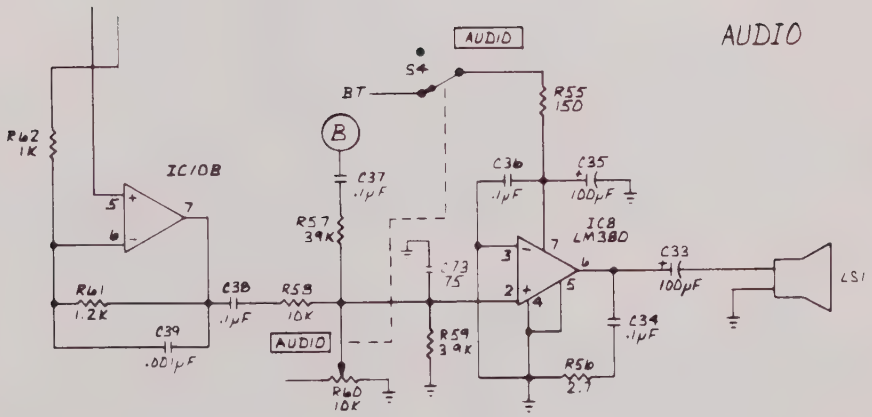
WAVETEK
SAM III/IIID MAIN BD
SHEET 2 OF 2

Drawn by D. J. WATSON	SCALE	DATE 5-18-82
CHK'D J LOY	DATE 6-07-84	DRAWING NO 0019-30-0014 SHEET 2 OF 2
RELEASED BY	DATE	

THEORY OF OPERATION

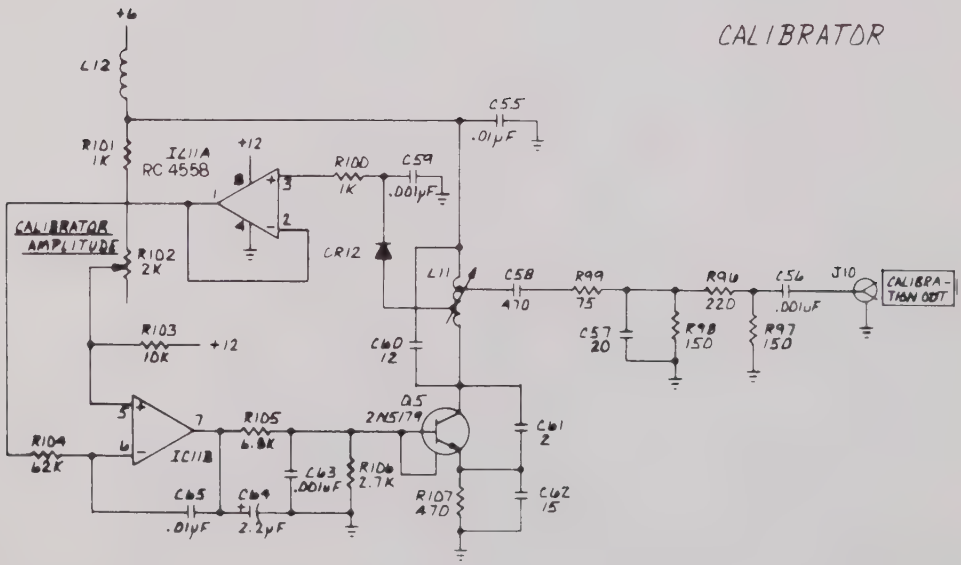
AUDIO

The demodulated signal at the output of IC5 is coupled by C37 to volume control R60. The discriminator output is amplified by IC10B and coupled to the wiper of R60. This allows for a clear reception of the FM signal. The wiper of R60 is connected to pin 2 of IC8. The IC8 has an internal gain of approximately 200. This signal is then coupled through C33 to the speaker. The purpose of C34 and R56 is to prevent high frequency (100kHz) oscillations.



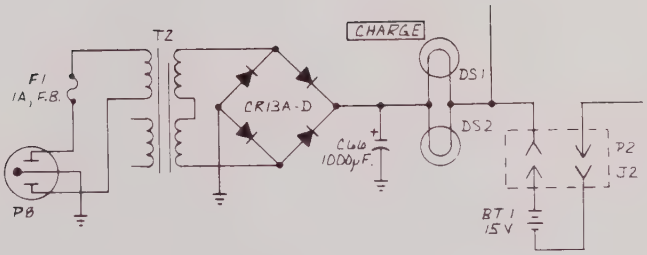
CALIBRATOR

Q5 is configured as a common base oscillator. The feedback is accomplished through C61. C60 and L11 form the frequency determining tank circuit. CR12 and C59 detect a sample of the output. This detected voltage is then buffered by IC11A and applied to a comparator IC11B, R101, R102, and R103 provide a reference voltage that is also applied to a comparator IC11B. If the output level of the oscillator decreases, the detected voltage decreases causing the voltage on the inverting port of the comparator to decrease. This decrease in voltage causes the output of the comparator to increase. Since this voltage supplies the base bias, the transistor is driven harder, thus causing the amplitude of the oscillator to increase. This action provides a very stable closed loop leveling of the oscillator amplitude. C58 couples the output of the oscillator to a 75 ohm attenuator pad. The output at +20 dBmV is connected to the front panel F connector.



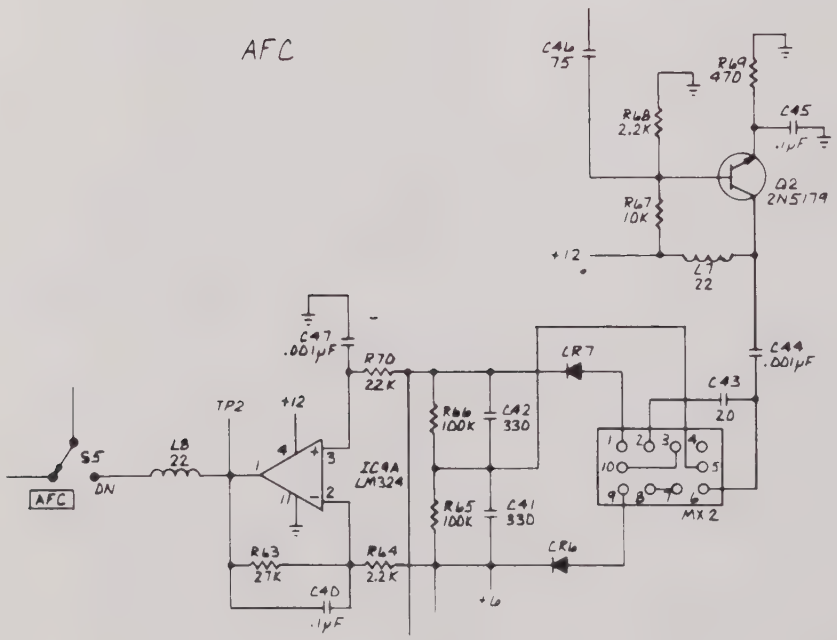
CHARGE CIRCUIT

110 VAC is applied through the front panel receptacle to transformer T2. T2 steps the voltage down to approximately 16 VAC. This voltage is then rectified by a full-wave bridge rectifier, CR-13. This voltage is filtered by C66 and applied to the battery by way of DS1 and DS2, which acts as a current limiter.



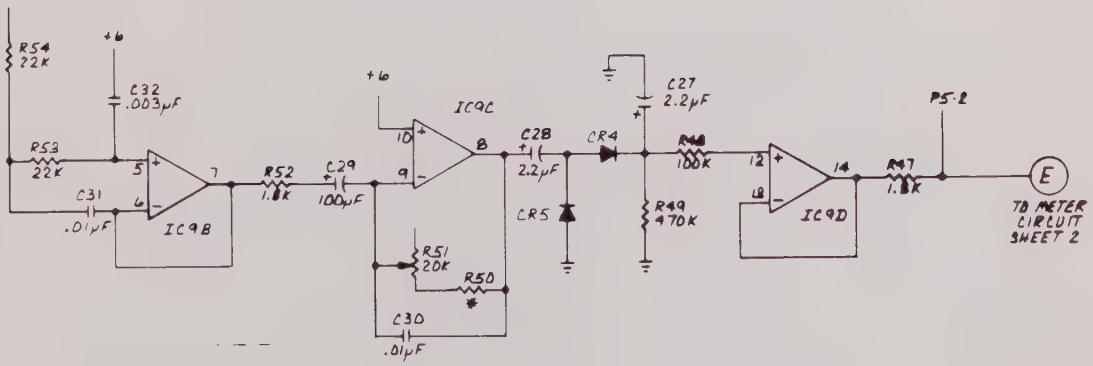
DISCRIMINATOR

The second output-pin of IC3 is a buffered output of the 10.7 MHz signal which is further amplified by Q2, which functions as a limiter. This amplified signal is then applied to the discriminator transformer (MX-2). The discriminator output as seen on pin 3 of IC9A will increase or decrease in voltage as the IF signal increases or decreases in frequency. This voltage is amplified by IC9A and the output pin 1, is applied to a varactor diode (BB105) in the 3rd L.O. (35.05 MHz). When the AFC switch is on, this voltage at the varactor will change. This changing voltage results in the 3rd L.O. increasing or decreasing in frequency, thus causing the mixed output to result in 10.7 MHz.



HUM

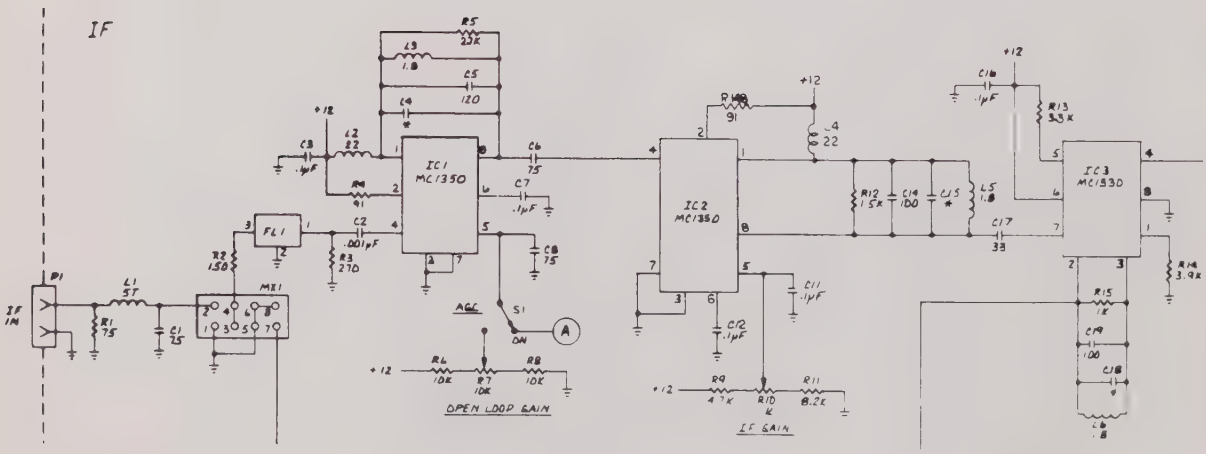
The hum circuit is designed to measure low frequency modulation signals. The peak detector circuit is disabled in the hum mode. It is disabled because you are not interested in reading a peak signal, but the amount of low frequency modulation onto the carrier. The output of the video amplifier (IC4 pin 6) is applied to an active filter consisting of IC9B. This active filter is designed to pass frequencies up to 500 Hz. This 500 Hz is to allow for an accurate measurement, if the hum is a square wave. Square waves contain frequencies higher than the fundamentals. The 60 Hz signal if present is AC coupled to IC9C, which amplifies the signal. This signal from IC9C provides a 6V reference. The AC signal is applied to a voltage doubler (P-P detector), consisting of CR4, CR5, C27 and C28. The DC voltage is buffered by IC9D and applied to the meter movement through R47.



HUM

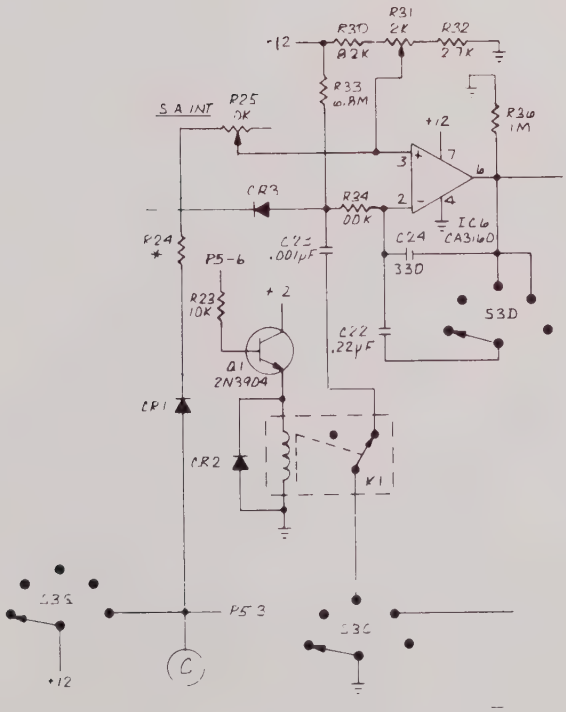
I.F.

The IF signal is applied at P1. The R1 is a 75 ohm termination. L1 and C1 provide a low pass filter. The signal is then mixed with a 35.05 MHz signal in MX-1. The resultant output of 10.7 MHz is applied to a ceramic filter FL-1, which limits the bandwidth to approximately 280 kHz. The signal is then amplified by IC1 (1350), which is capable of 50 dB of gain. The IC1 has an AGC range of 60 dB. This circuit has to be tuned to 10.7 MHz in order to achieve the high gain. This tuning is accomplished by C4, C5 and L3. The R5 provides decueing to allow for correct bandwidth. This amplified signal is capacitively coupled to IC2, which provides an additional 20 dB of gain. This gain can be varied by R10. This may need to be changed to provide optimum meter tracking. This circuit also needs to be tuned to 10.7 MHz by C14, C15 an L5. The R12 provide decueing to allow for correct bandwidth. This amplified signal is applied to IC3, which provides additional gain and incorporates the video detector. This circuit is tuned to 10.7 MHz by C18, C19 and L6. The R15 provides decueing to allow for correct bandwidth. At TP-1 there isn't any RF present, however there is some modulation.



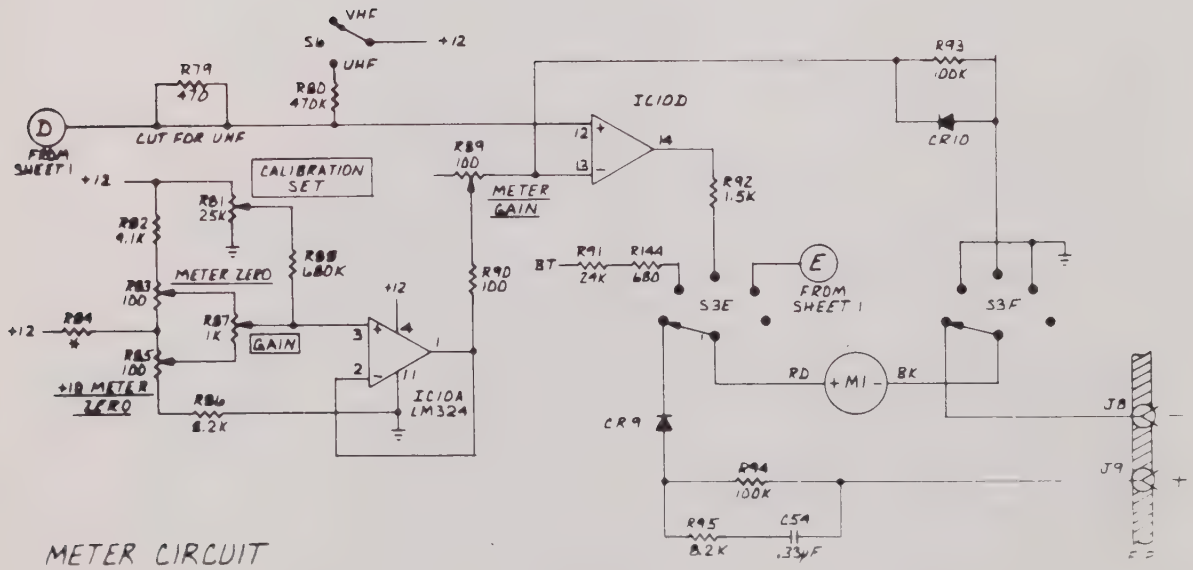
INTEGRATOR

The integrator is a comparator used to supply the AGC voltage. A reference voltage is set up on pin 3 of IC6, which is controlled by R31. When a strong IF signal is applied to the IF input, the voltage on pin 2 decreases. As this voltage decreases, the voltage on pin 6 increases. This signal is buffered by IC10C. The output at pin 8 is applied to pin 5 of IC1. This feedback will decrease the gain of the 1350. This AGC loop maintains a constant signal level through the IF. The purpose of C22 and C24 is to slow the comparator to prevent oscillations. When in the spectrum analyzer mode, 12V is applied to CR1 through R24 and R25. This changes the integrator reference voltage a very small amount. This integrator voltage changes the gain of the IF (since the integrator supplies the AGC voltage). The R25 adjusts this level for the best spectrum analyzer display.



METER CIRCUIT

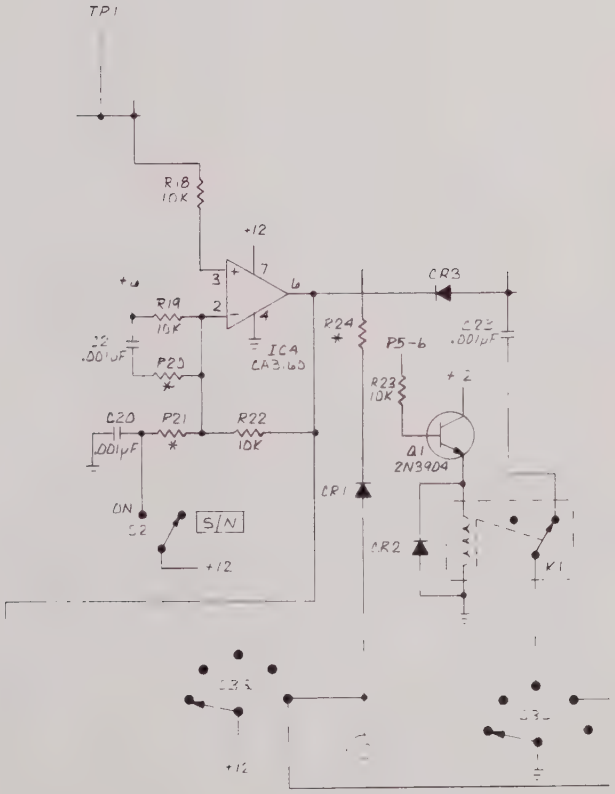
The meter circuit is driven by the AGC voltage rather than the detected IF. The purpose of IC10A is to provide a reference voltage to be compared with the AGC voltage. The main reference is set up by R82, R83, R84, and R85. The R81 will provide a small amount of deviation to this main reference voltage. The R87 is used to increase this reference voltage a very small amount, to boost the meter reading by 10 dB for reading the low signal levels. IC10A is merely a buffer to provide isolation between the voltage divider and the meter amplifier. IC10D is a voltage to current converter. As the voltage increases on pin 10 above the voltage on pin 13, the voltage on pin 14 also increases. This voltage at pin 14 will cause current to flow through the meter and through CR10. The CR10 is forward biased and therefore allows the current to flow back through R92 to IC10D. Since the amount of gain is determined by the feedback resistance divided by the input resistance, the gain can be varied by the input resistance of R89. The R89 is used to calibrate the high end of the meter.



METER CIRCUIT

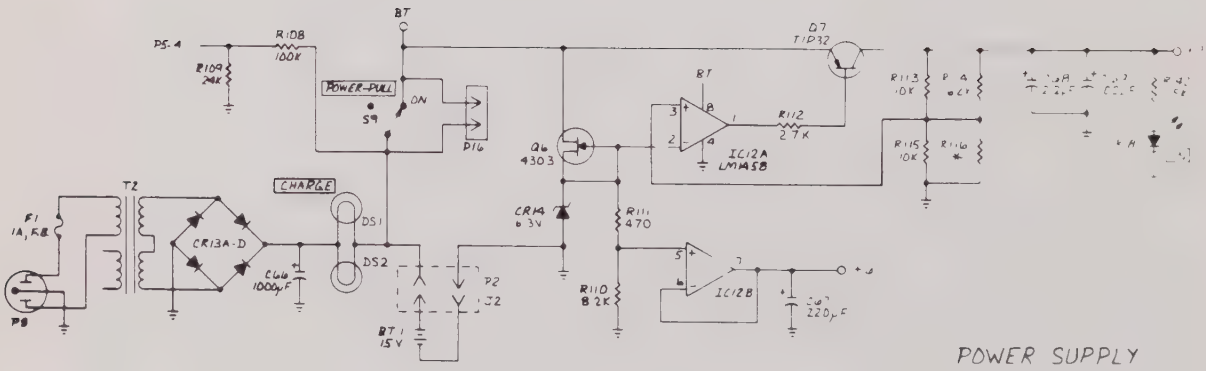
PEAK DETECTOR

The detected output from th IF is amplified by IC4 and is fed to a peak detector of CR3 and C23. The purpose of this detector circuit is to charge up C23 to the peak value of the modulation. All signal level meters measure peak value not average or RMS values. No detector is perfect and since C23 will discharge a certain amount, this voltage will still not be an absolute peak value. The purpose of C21 and R20 is to boost the gain of IC4 a small amount when video modulation is present. The C23 provides a ground path for the peak detector circuit.



POWER SUPPLY

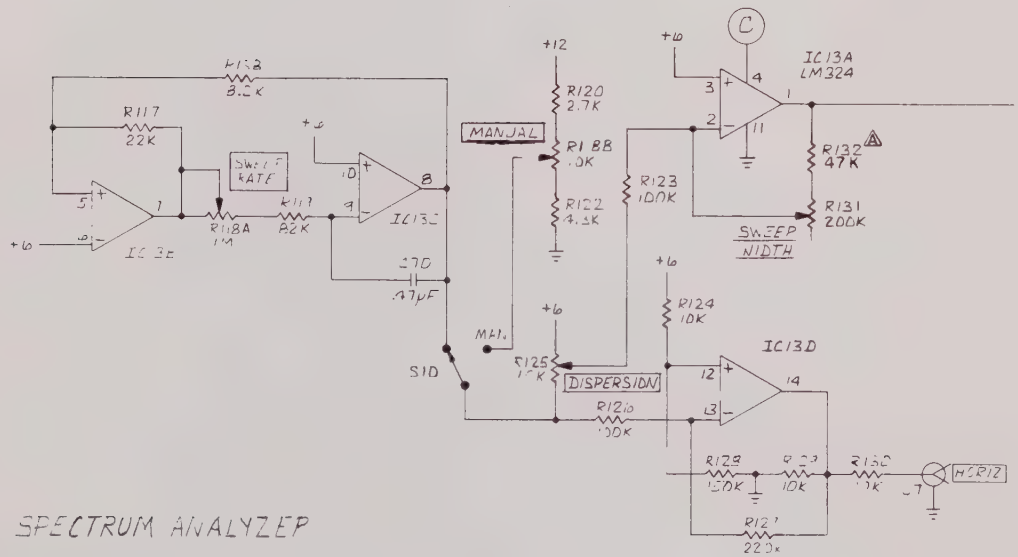
Q6 supplies a constant current source for zener diode CR14. The CR14 provides a 6.2 V reference, which goes to a voltage divider of R110 and R111. This 6.2V reference is buffered by IC12B. The 6.2 V reference is applied to the inverting port of comparator IC12A. When power is first applied, the output on pin 1 of IC12A will be high, which causes Q7 to conduct very slightly. This allows only a small voltage to be seen on the output of the supply. The supply voltage is applied to a voltage divider of R113, R114, R115 and R116. The voltage divider cuts voltage approximately in half. This voltage is applied to the non-inverting port of IC12A. Since this voltage is lower than the voltage on pin2, the output on pin 1 will decrease, Q7 conducts harder, which supplies a higher supply voltage. The supply voltage is requlated by comparing the values of the two input voltages of IC12A. R116 is chosen to result in a 12V reference.



POWER SUPPLY

SPECTRUM ANALYZER

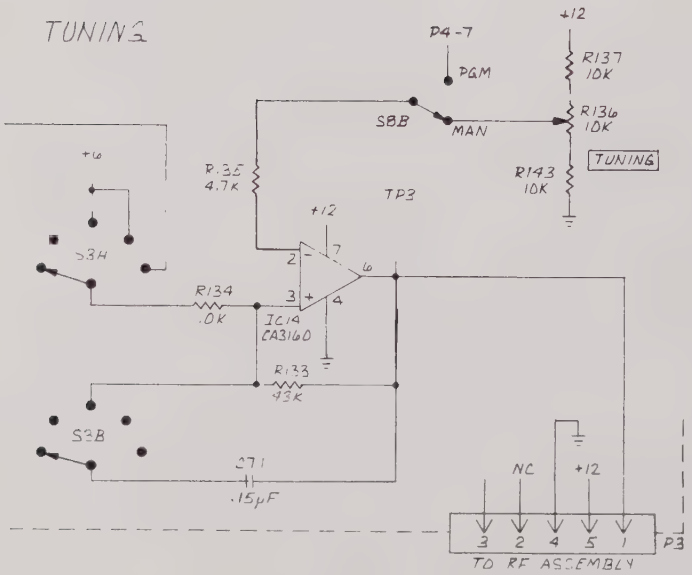
IC13B and IC13C form a ramp oscillator, whose frequency is varied by R118. This ramp voltage is applied to IC13D, where it is amplified to provide the horizontal drive required for the oscilloscope. The ramp output from IC13C is also applied to a separate amplifier of IC13A. The IC13A's output (an inverted ramp), is applied to the tuning circuit. The IC13A causes the 1st L.O. frequency to increase and decrease corresponding with the horizontal drive to the oscilloscope. The dispersion potentiometer (R125) is used to increase or decrease the amplitude of the ramp signal applied to the tuning section. This dispersion potentiometer allows for a small or large span of frequencies. The auto/manual switch (S5) allows the tuning and voltage to be varied manually, by adjusting the manual sweep potentiometer (R118).



SPECTRUM ANALYZER

TUNING CIRCUIT

This circuit consists of a series of voltage divider networks, which can be switched between bands by S201. The two voltages, which are selected by S201 and applied to pin 5 of IC201A and pin 3 of IC201B, are buffered through the 1458 to provide isolation. These two outputs are then applied to R136 on the front panel. The wiper of R136 (course tuning potentiometer) will have a voltage corresponding to the band selected on the front panel. This voltage is amplified by IC14 and its output (pin 6) is then applied to RF assembly. R137 and the fine tuning potentiometer allow for a very small change in the output voltage.

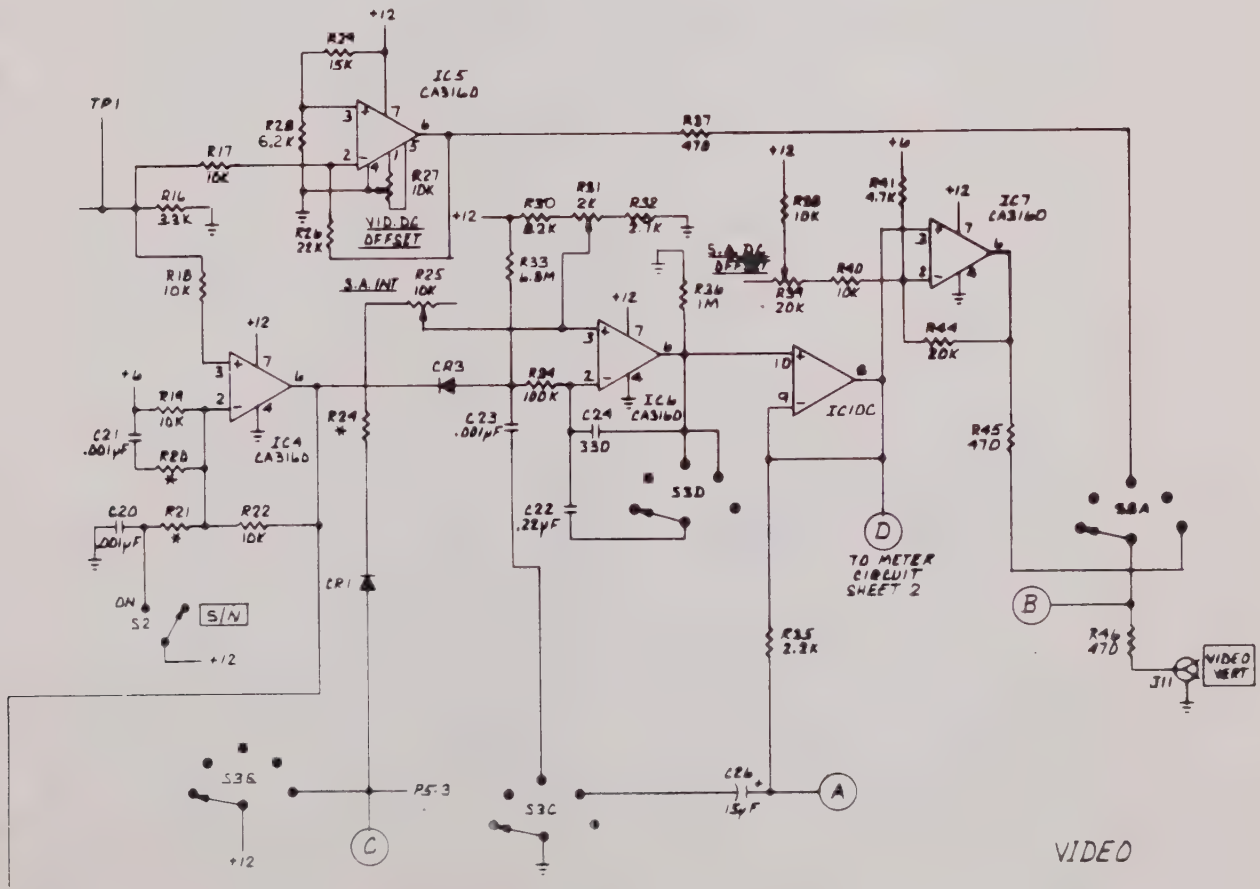


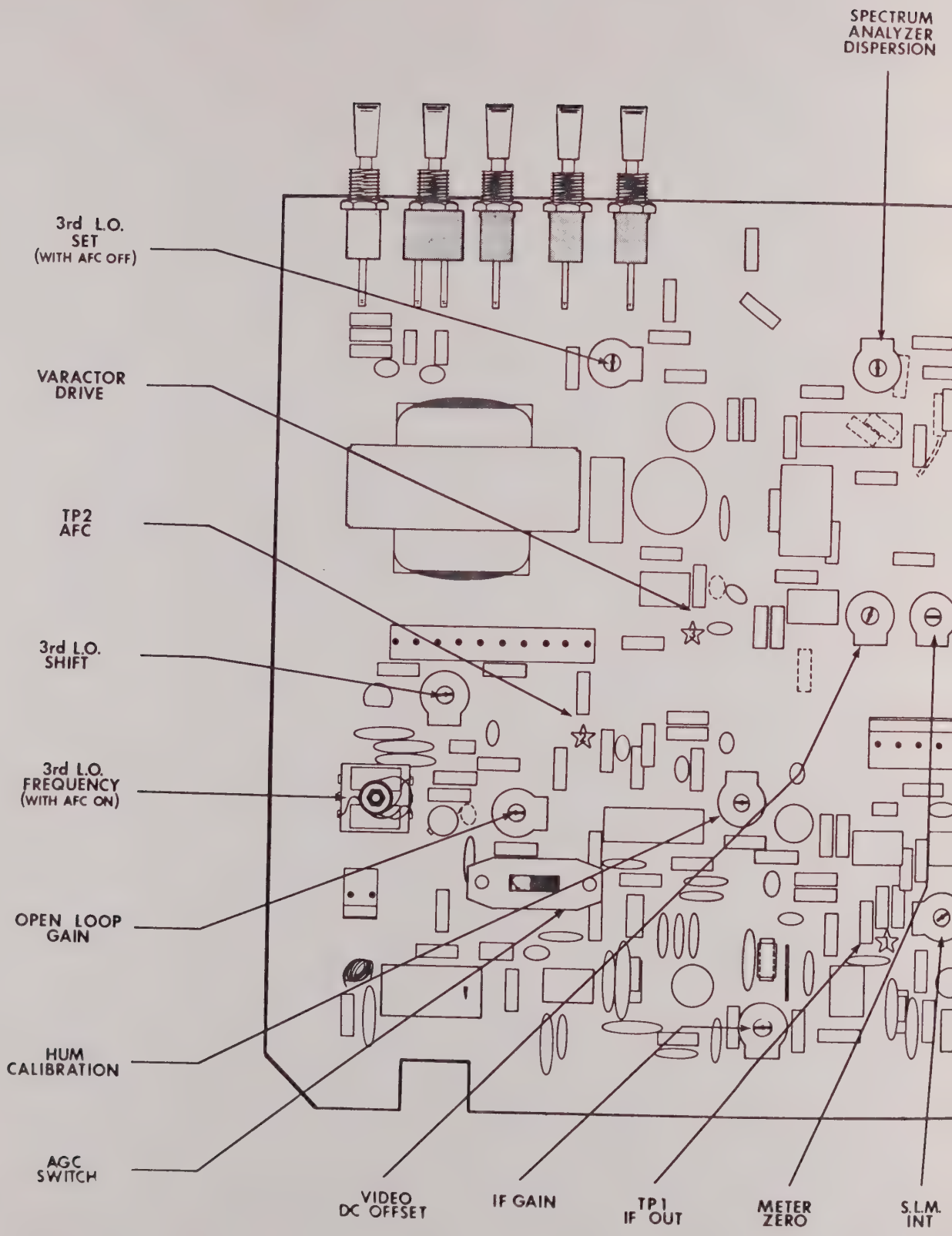
VERTICAL/VIDEO AMPS

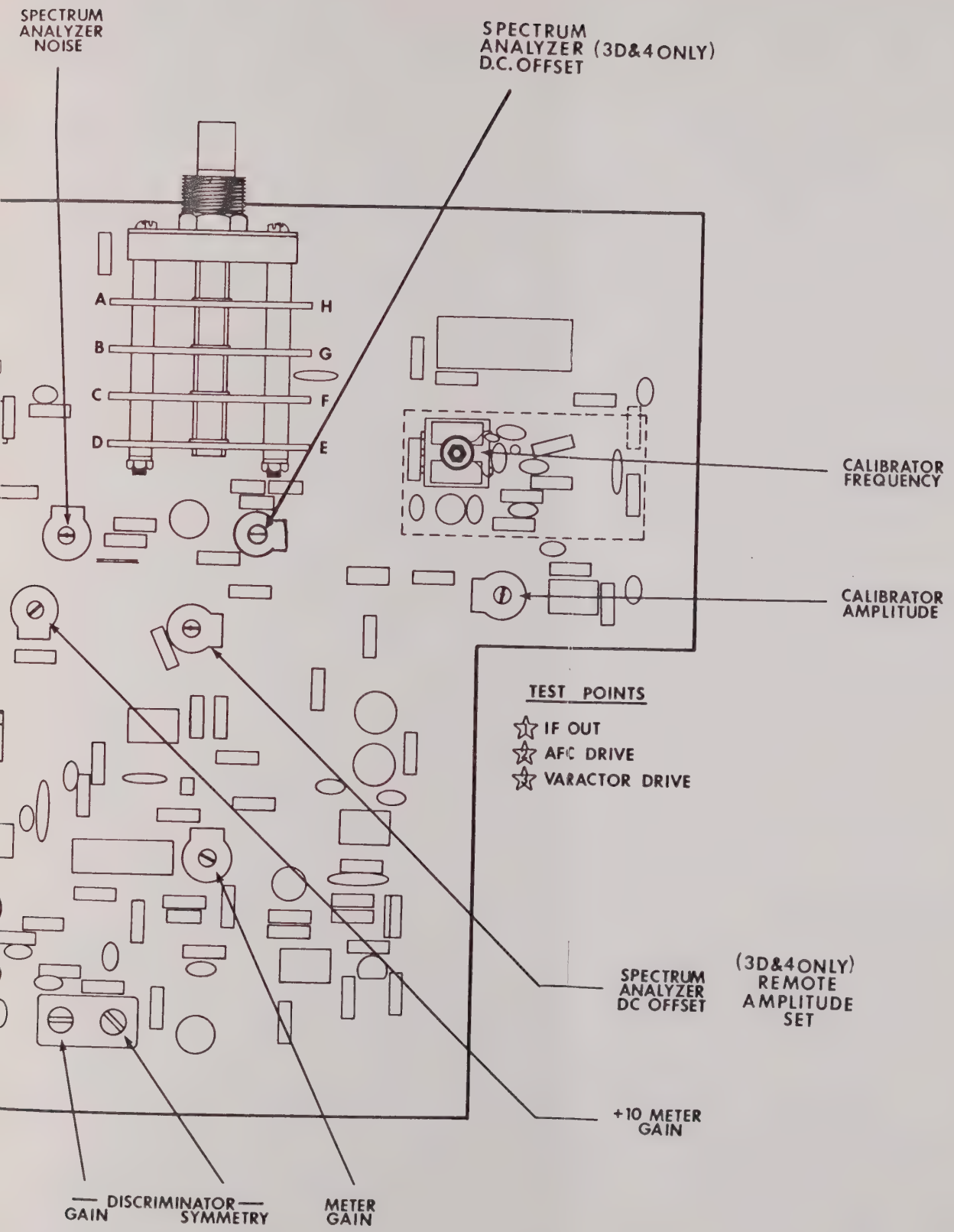
The purpose is to provide a video output that can be monitored with an oscilloscope. The detected signal from IC3 pin 4 is amplified by IC5 and fed through S3A (function switch) to the front panel F connector. The combination of R28 and R29 and the DC offset potentiometer (R27) is to provide an offset voltage of approximately .2V. The IC7 provides the vertical output for the oscilloscope in the spectrum analyzer mode. The IC7 amplifies the AGC voltage from IC10C, pin 8. The R38, R39, R40 and R41 provide an offset voltage to place the baseline of the noise level at OV.

The R42 and R43 provide a sample voltage corresponding to the amplitude of the signal level. This voltage is applied to the microprocessor board. This voltage will determine the actual signal level and take a remote reading. The purpose of C25 is to filter out any spikes to prevent erronous remote amplitude readings.

Since the normal DC offset R39 is used to adjust the remote signal level reading another means of adjusting the baseline of the noise level is required. This adjustment is accomplished by applying 12V to CR9 and R146 is adjusted to provide the proper baseline.




SPECTRUM ANALYZER DISPERSION
3rd L.O. SET (WITH AFC OFF)
VARACTOR DRIVE
TP2 AFC
3rd L.O. SHIFT
3rd L.O. FREQUENCY (WITH AFC ON)
OPEN LOOP GAIN
HUM CALIBRATION
AGC SWITCH
VIDEO DC OFFSET
IF GAIN
TP1 IF OUT
METER ZERO
S.L.M. INT


SPECTRUM ANALYZER NOISE
SPECTRUM ANALYZER (3D&4 ONLY) D.C. OFFSET
A
B
C
D
H
G
F
E
CALIBRATOR FREQUENCY
CALIBRATOR AMPLITUDE
TEST POINTS
IF OUT
AFC DRIVE
VARACTOR DRIVE
SPECTRUM ANALYZER DC OFFSET
(3D&4 ONLY) REMOTE AMPLITUDE SET
+10 METER GAIN
GAIN
DISCRIMINATOR SYMMETRY
METER GAIN

SAM III MAINBOARD PRELIMINARY CALIBRATION

I. Physical Inspection
   1) Examine unit for defects.

II. Voltmeter
   1) Place function switch to "volts" position.
   2) Connect a voltage source to the front panel voltmeter jacks and check meter reading. Accuracy must be ±5%.

III. Charge Circuit
   1) Plug A.C. charge cord into 110Vac and connect to the unit. Connect a dummy battery of 110 ohm in place of a battery or power source.
   2) Turn the unit on and the "ON" charge lamp on the main PCB should light. Turn unit off and the charge lamp should dim.

IV. Power Supply
   1) Connect battery cable to external power supply at 14V.
   2) Turn on power switch and check 6V supply for 5.58V to 6.1 V.
   3) Connect voltmeter to 12V supply and select resistor value of R116 to read 12.0V to 12.1V.
   4) Place function switch in the "batt. ck" position and lower the voltage source to 12.5V The meter should read "recharge".
   5) Vary the voltage source from 12.5V to 16.0V. The supply should not change more than ±.005V.

V. Meter and Display Lights
   1) Turn on light switch, the two lamps in the meter should light.

VI. Varactor Drive
   1) Function switch needs to be in SLM mode.
   2) Connect a voltmeter to test point 3 (pin 6 of IC14). Turning the tuning potentiometer from one extreme to the other should produce a varactior drive voltage of 0 to 12V.(0=.05V maximum,12=11.8V minmum).

VII. Spectrum Analyzer
(Analyzer Units Only)
   1) Connect scope probe demod in of 1801 sweeper to horizontal output connector of the SAM.
   2) Set vertical sensitivity to 2V per division, and horizontal time base to 5ms.
   3) Place the function switch in Spectrum Analyzer mode.
   4) Place sweep rate/manual switch in the manual position. By varying manual control potentiometer, you should see a voltage go from 0 to 9V.
   5) Place sweep rate/manual switch in sweep rate position. By varying sweep rate control potentiometer, you should see a sawtooth waveform go from o to 9V with waveform varying from flat to full angle.

VIII. 3rd L.O.

1) Must be in open loop. (Slide switch S1 is in its right side position.)
2) Place function switch in SLM position. Turn AFC on.
3) Connect a pick off loop to a frequency counter capable of reading 35.05 MHz.
4) Hold up the pick off loop near the 3rd L.O. tuning coil (T1), as far away as possible to maintain as accurate reading.
5) Using a tuning stick, adjust slug in coil (T1) for a frequency of 35.05 MHz. Turn off AFC and adjust R73 for 35.05 MHz.
6) Repeat step 5 above until AFC off and AFC on, both result in a frequency of 35.05 MHz ±.03 MHz.

IX. Sweep IF

1) Must be in open loop.
2) Using an IF cable, inject a signal at the IF input on the mainboard.
3) Adjust sweep to center frequency of 45.75 MHz, sweep width 1MHz at +20 dBmV and sweep rate = 100 msec.
4) Connect a scope probe to the video vertical connector on the Sam.
5) Set scope vertical position to .2 V per division.
6) Set the scopes horizontal input to .5 V per division and connect the scope to the horizonial output of the sweeper.

X. Video Offset

1) Must be in open loop.
2) Adjust R27 for a dc level of .1 V above ground.
3) Adjust R7 for an open loop gain for about a 1 V signal.

XI. AFC

1) Must be in open loop.
2) Connect scope probe to test point 2.
3) Set scope vertical to 1 V per division and adjust the pink slug of the discriminator for maximum amplitude, and the blue slug for symetrical waveform. The signal should be at least 4 V peak to peak.

XII. Tune IF

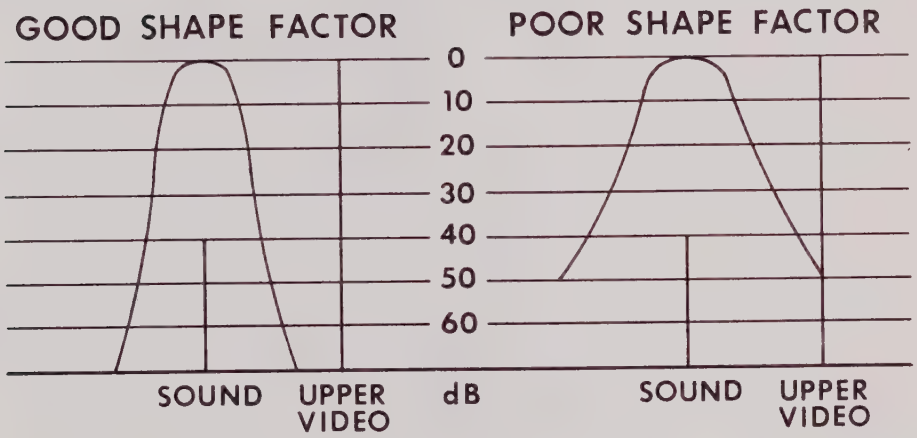
1) Must be in open loop.
2) Re-connect the scope probe to the video vertical connector on the Sam.
3) Scope vertical sensitivity should be .2 V per division.
4) Using ttest probe, inject a signal at pin 1 of IC2 (1550).
5) Adjust sweep to 10.7 MHz center frequency, sweep width of about 1 MHz and amplitude to + 10 dBmV.
6) Select capacitance values across the 2nd and 3rd tank circuits in the IF, C15 and C18 until the response is centered a 10.7 MHz. Remove test probe.

XIII. Shaping Response

1) Must be in open loop
2) Using an IF cable, inject a signal at the IF input of the Sam.
3) Frequency should be at 45.75 MHz, sweep width = 1 MHz, at +20 dBmV.

4) If necessary, select a capacitor value C4 across the first IF tank circuit to acheive a flat or haystacked response, rather than a tilted, notched or pointed response. Solder capacitor in place.

REFER TO PICTURES BELOW FOR TYPICAL GOOD IF RESPONSE AND BAD IF RESPONSE



XIV. Open Loop Gain

1) Set scope vertical to 1 V per division and adjust the pink slug of the discriminator for maximum amplitude, and the blue slug for a symetrical waveform. The signal should be at least 4V peak to peak.

XV. AFC

1) Must be in open loop.
2) Connect scope probe to test point 2.
3) Set scope vertical to 1 V per division and adjust the pin slug of the discriminator for maximum amplitude, and the blue slug for symetrical waveform. The signal should be at least 4 V peak to peak.

XVI. Integrator

1) Must be in closed loop.
2) Connect scope probe to test point 1, pin 4 of IC3 (1330).
3) Set scope vertical to .5 V per division, and adjust vertical position until an inverted response appears.

4) Close loop switch and place sweeper in manual sweep mode. Sweep through from no signal to a maximum frequency signal. The maximum signal condition should lower the response by .4 V.
5) Adjust R31 for a .4 V difference.

XVII. Meter Tracking

1) Must be in closed loop.
2) Place function switch to the SLM mode, set potentiometers R81 (cal. set), R84 (10 dB gain), R87 (+10), R83 (-10) and IF gain to center of their positions.
3) Front panel +10 dB gain potentiometer should be in cal position.
4) Using an IF cable, inject a signal from an MC-50 or your meter calibrator,at 45.75 MHz and at +20 dBmV. Watch the meter, adjust frequency of MC-50 for maximum amplitude.
5) If necessary, select a resistor value R84 to achieve a mid scale reading.
6) Re-adjust frequency of MC-50 for a maximum meter reading and repeat step 5 above if necessary.
7) Reduce MC-50 amplitude by 10 dB and adjust R83 for a left scale reading. Return amplitude to original +20 dB.
8) Increase amplitude by 10 dB and adjust R85 for a right scal reading. Return amplitude to original +20 dB.
9) Repeat step 7 above.
10) Reduce amplitude by 10 dB and turn front panel +10 dB gain potentiometer fully clockwise and adjust R89 for a mid scale reading. Return front panel +10 dB gain potentiometer to "cal" position. Reset R83 to read left scale.
11) Repeat steps 7 and 10 above.

XVIII. Peak Detector

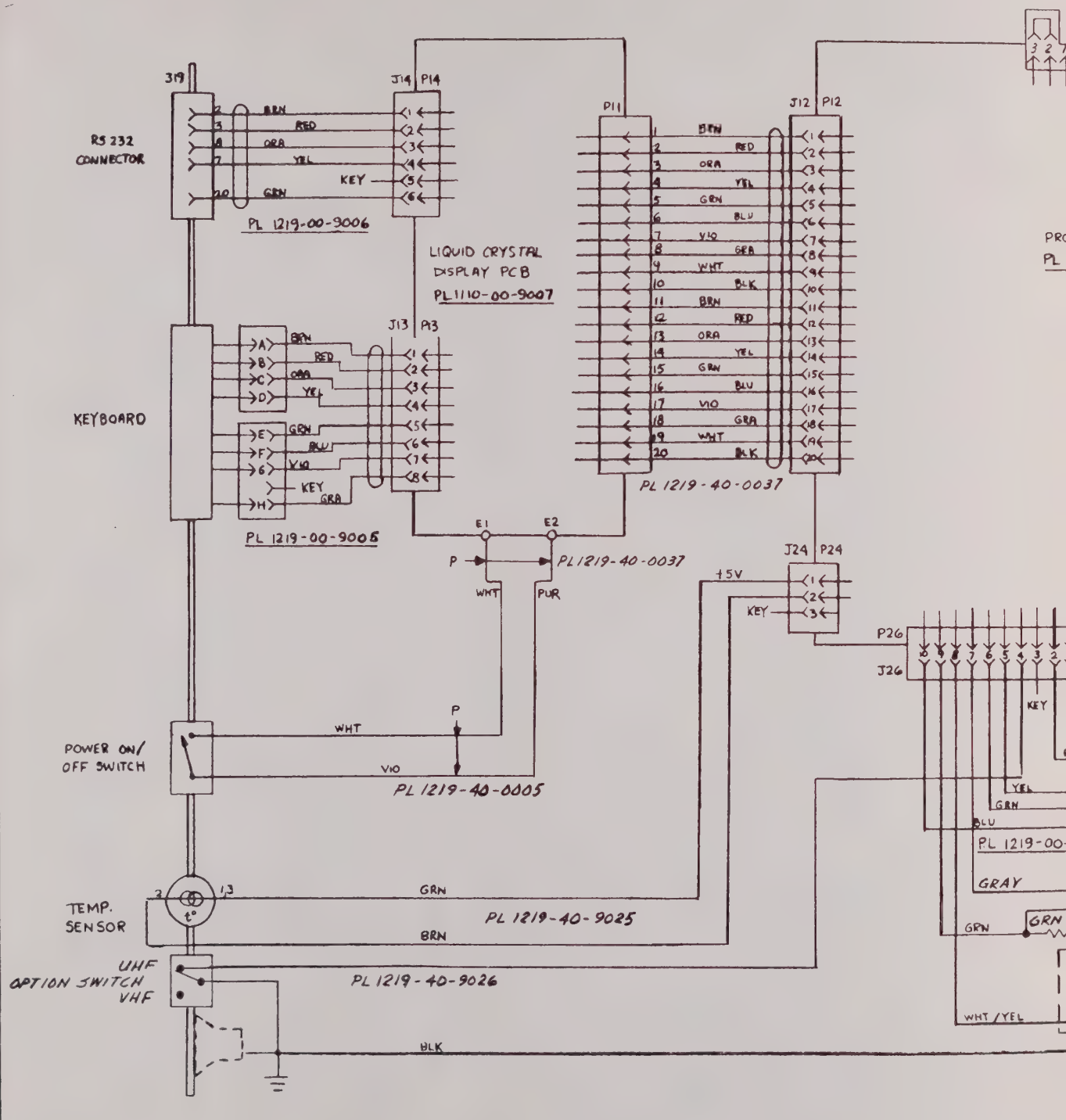
1) Connect an MC50 to the RF input of the Sam and peak on a signal. Press the modulation switch of the MC50, the needle of the meter should drop. Select a resistor and complete the circuit at position R20. Change the value of this resistor 27K ohm ±10K ohm until a needle drop of no more than .2 dB is achieved.

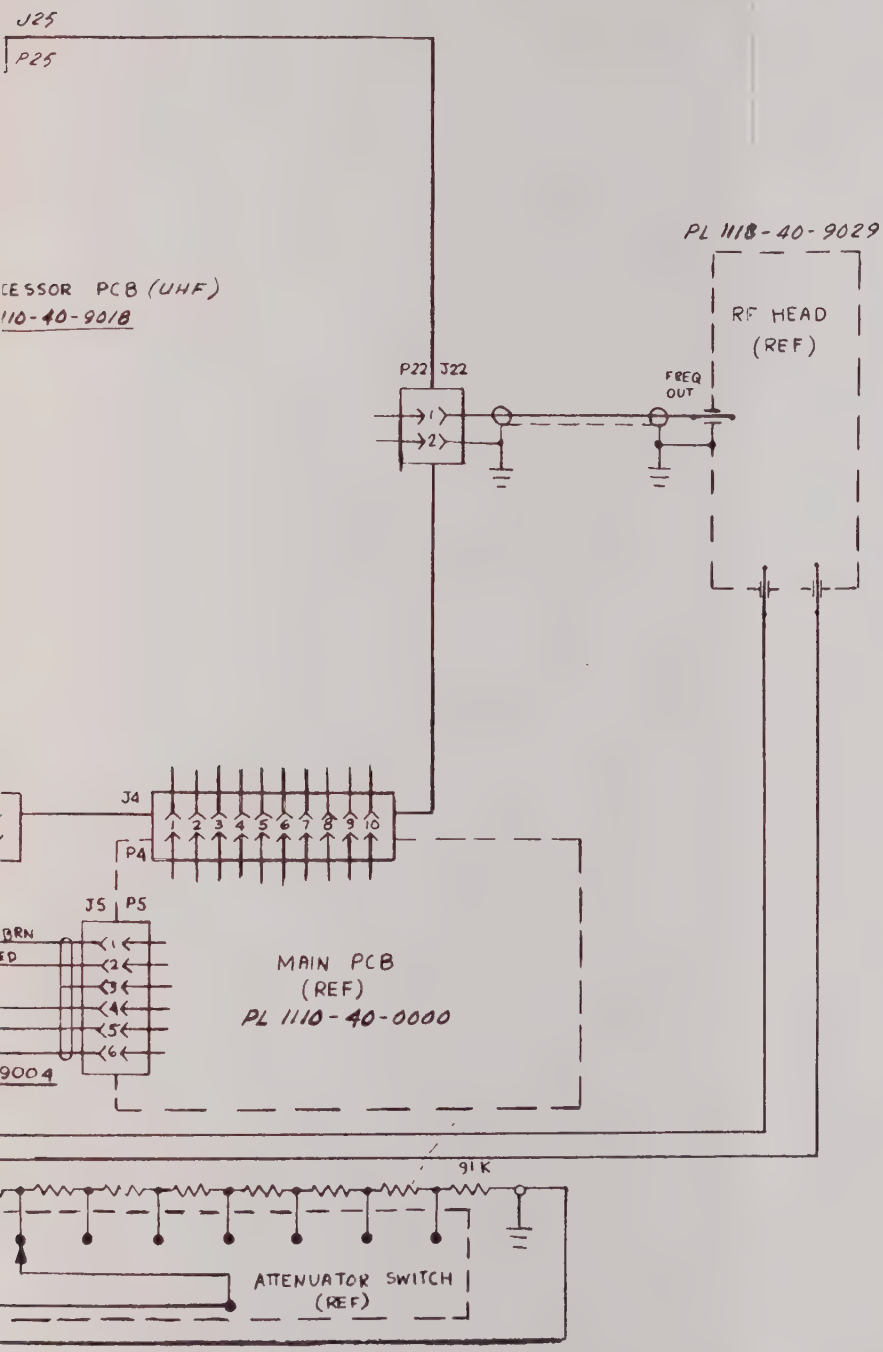
XIX. Hum

1) Use 27K ohm resistor to complete circuit position R50, check circuit.
2) Adjust R50 for mid scale, then switch a calibrated hum source from 2% to 4% hum modulation.
3) Adjust hum R50 for 2% and 4% meter scale. If unable to center, raise or lower resistor.

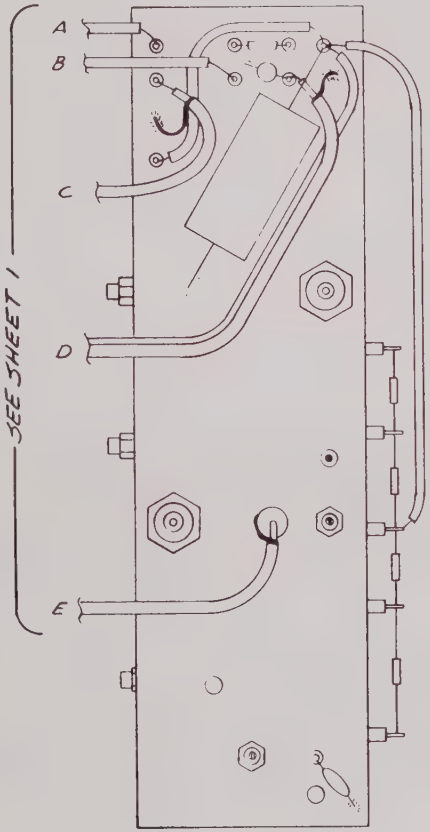
XX. Calibrator

1) Connect the calibrator output to a frequency counter capable of measuring 150 MHz.
2) Adjust the oscillator tuning slug, L11 for a frequency of 150 MHz and verify that the calibrator amplitude R102 does not alter the frequency more than 2 MHz.
3) Connect the calibrator output to a Sam and adjust the calibrator amplitude R102 to achieve +20 dBmV. Verify that the potentiometer still has ±2 dB of range, minimum.
4) Solder calibrator shielding can in place reset the frequency to 150 MHz ±.1 MHz.


RS 232 CONNECTOR
J19
J14 P14
BRN
RED
ORA
YEL
KEY
GRN
PL 1219-00-9006
LIQUID CRYSTAL DISPLAY PCB
PL1110-00-9007
P11
J12 P12
BRN
RED
ORA
YEL
GRN
BLU
VIO
GRA
WHT
BLK
PL 1219-40-0037
KEYBOARD
J13 P13
A
B
C
D
E
F
G
H
BRN
RED
ORA
YEL
GRN
BLU
VIO
KEY
GRA
PL 1219-00-9005
E1
E2
P
PL1219-40-0037
WHT
PUR
J24 P24
+5V
KEY
P26
J26
POWER ON/ OFF SWITCH
WHT
P
VIO
PL 1219-40-0005
TEMP. SENSOR
GRN
BRN
PL 1219-40-9025
UHF
OPTION SWITCH
VHF
PL 1219-40-9026
BLK
GRAY
WHT/YEL



	WAVETEK		
	Schematic Diagram Processor PCB/LCD PCB Interface		
1	Paul Sims	3/4/83	0414-30-9019



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TOLERANCE:
DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED

NO.	DESCRIPTION	BY
	REVISION	

MATERIAL: ———

FINISH: ———

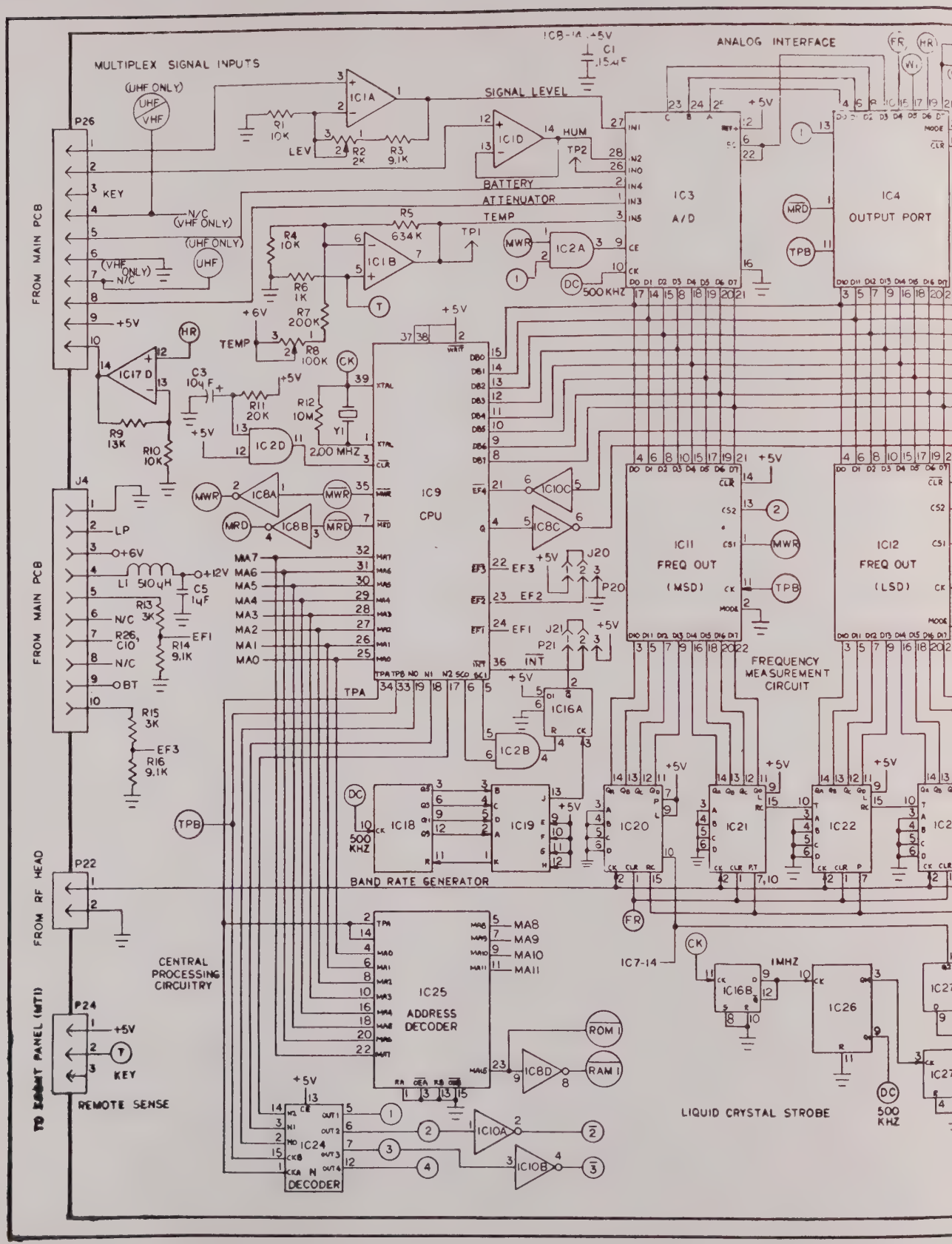
ARTWORK #: ———

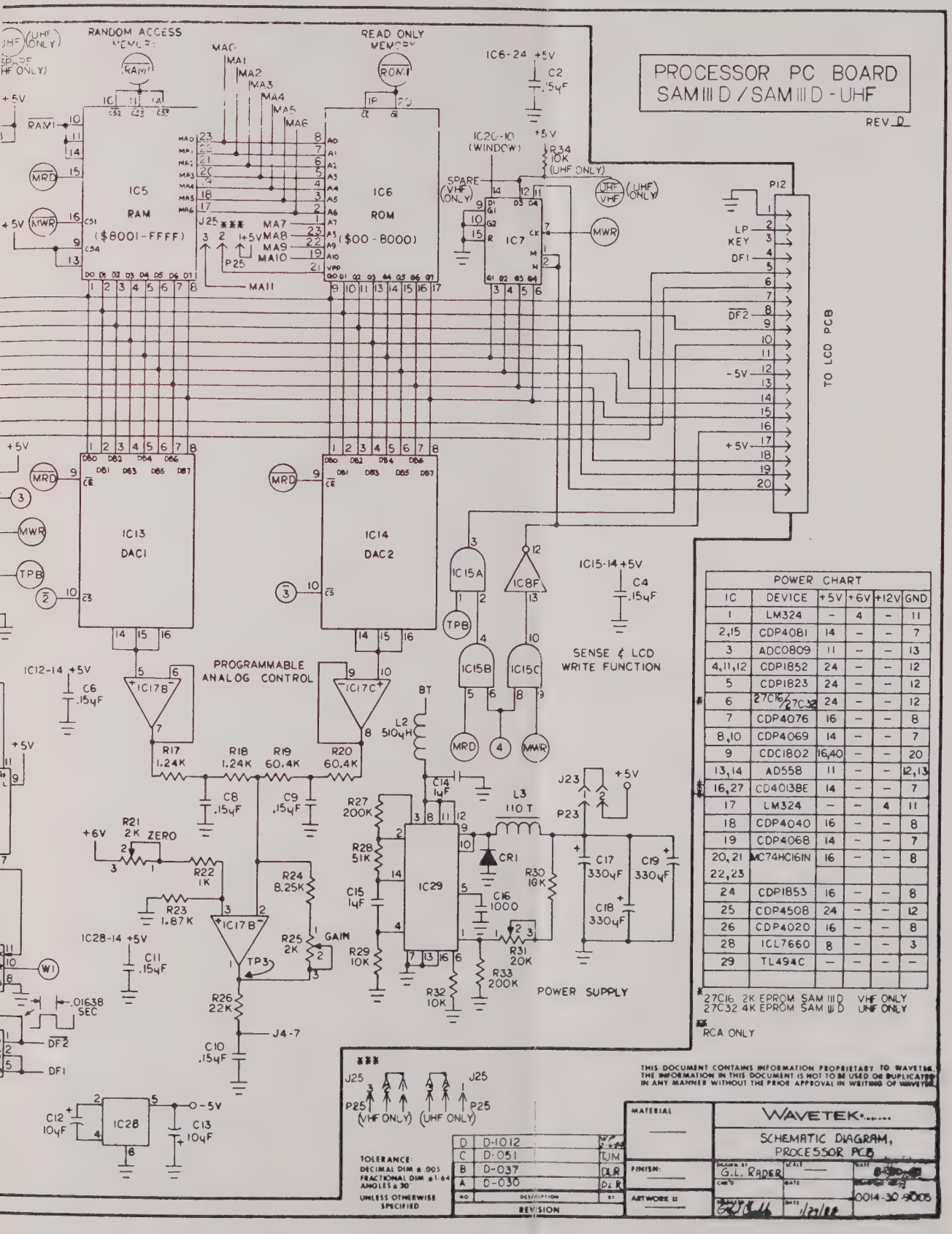
WAVETEK INDIANA

ASSY DWG, PROCESSOR PCB/ LCD PCB INTERFACE

DRAWN BY: BRYNAN	SCALE: ———	DATE: 2-10-83	
CHK'D: Scott Simons	DATE: 2/14/83	DRAWING NO.: 0412-10-9026	
RELEASED BY:	DATE:		

SHEET 2


MULTIPLEX SIGNAL INPUTS
ANALOG INTERFACE
SIGNAL LEVEL
BATTERY
ATTENUATOR
TEMP
IC3 A/D
IC4 OUTPUT PORT
IC9 CPU
IC11 FREQ OUT (MSD)
IC12 FREQ OUT (LSD)
FREQUENCY MEASUREMENT CIRCUIT
BAND RATE GENERATOR
CENTRAL PROCESSING CIRCUITRY
IC25 ADDRESS DECODER
IC24 N DECODER
REMOTE SENSE
LIQUID CRYSTAL STROBE
FROM MAIN PCB
FROM MAIN PCB
FROM RF HEAD
TO FRONT PANEL (MTI)
P26
P22
P24
J4
J20
J21
P20
P21
TPA
TPB
+5V
+6V
+12V
500 KHZ
1MHZ
2.00 MHZ



POWER CHART					
IC	DEVICE	+5V	+6V	+12V	GND
1	LM324	–	4	–	11
2,15	CDP4081	14	–	–	7
3	ADC0809	11	–	–	13
4,11,12	CDP1852	24	–	–	12
5	CDP1823	24	–	–	12
6	27C16/27C32	24	–	–	12
7	CDP4076	16	–	–	8
8,10	CDP4069	14	–	–	7
9	CDC1802	16,40	–	–	20
13,14	AD558	11	–	–	12,13
16,27	CD4013BE	14	–	–	7
17	LM324	–	–	4	11
18	CDP4040	16	–	–	8
19	CDP4068	14	–	–	7
20,21	MC74HC16IN	16	–	–	8
22,23					
24	CDP1853	16	–	–	8
25	CDP4508	24	–	–	12
26	CDP4020	16	–	–	8
28	ICL7660	8	–	–	3
29	TL494C	–	–	–	–

27C16 2K EPROM SAM III D VHF ONLY
27C32 4K EPROM SAM III D UHF ONLY
RCA ONLY

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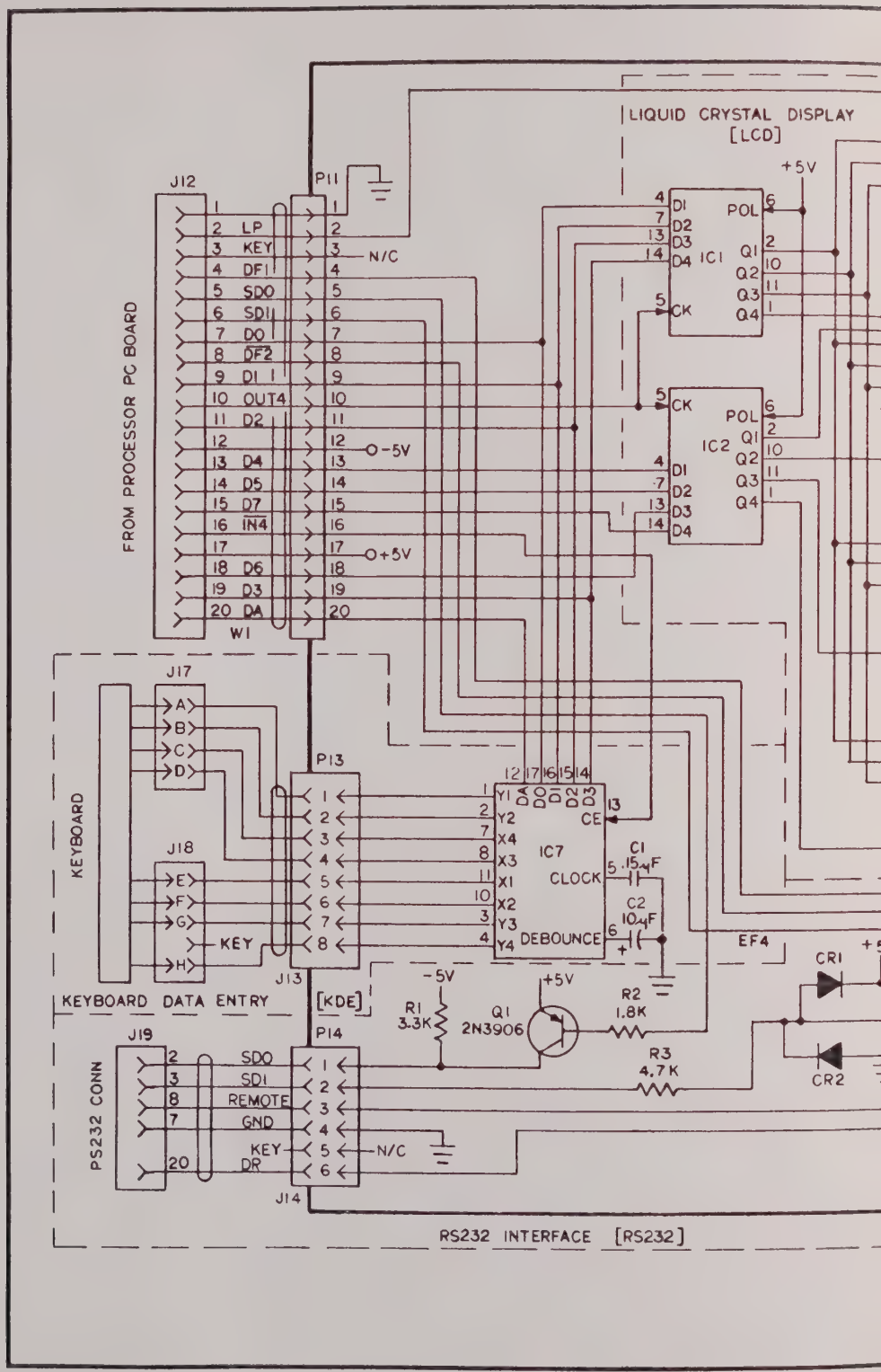
REVISION		
NO	DESCRIPTION	BY
D	D-1012	
C	D-051	TJM
B	D-037	DLR
A	D-030	DLR

TOLERANCE: DECIMAL DIM ±.005 FRACTIONAL DIM ±1/64 ANGLES ±30' UNLESS OTHERWISE SPECIFIED

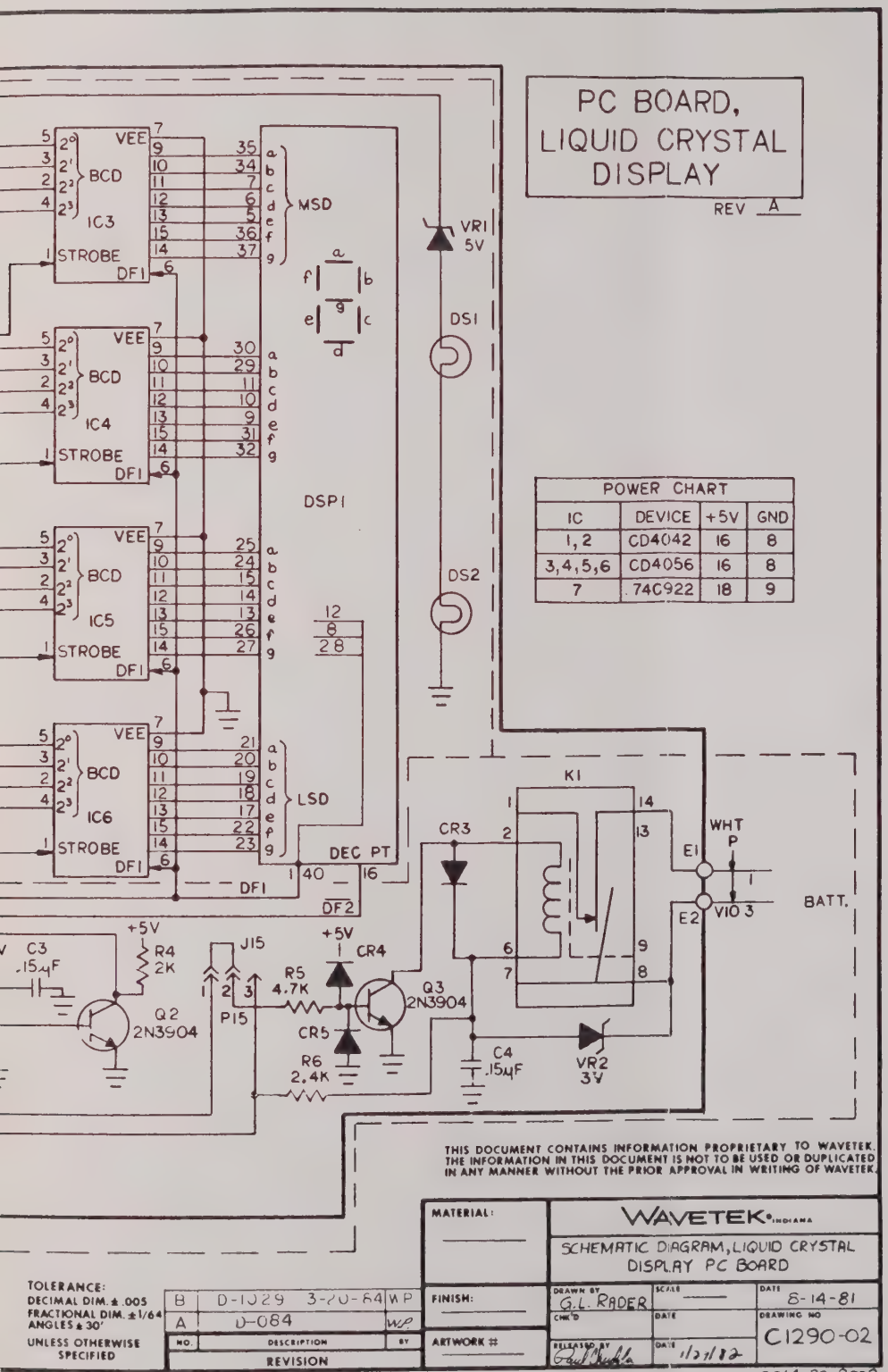
MATERIAL: —
FINISH: —
ARTWORK #: —

WAVETEK
SCHEMATIC DIAGRAM, PROCESSOR PCB
DRAWN BY G.L. RADER
DATE 1/21/88
0014-30-9005


LIQUID CRYSTAL DISPLAY [LCD]
FROM PROCESSOR PC BOARD
J12
P11
W1
LP
KEY
DF1
SDO
SDI
DO
DF2
DI
OUT4
D2
D4
D5
D7
IN4
D6
D3
DA
N/C
0-5V
0+5V
+5V
IC1
IC2
POL
CK
DI
D2
D3
D4
Q1
Q2
Q3
Q4
KEYBOARD
J17
J18
J13
P13
A
B
C
D
E
F
G
H
KEY
IC7
CLOCK
DEBOUNCE
CE
C1
.15μF
C2
10μF
EF4
CR1
CR2
R1
3.3K
R2
1.8K
R3
4.7K
Q1
2N3906
-5V
+5V
KEYBOARD DATA ENTRY
[KDE]
J19
P14
J14
PS232 CONN
SDO
SDI
REMOTE
GND
KEY DR
N/C
RS232 INTERFACE [RS232]

PC BOARD, LIQUID CRYSTAL DISPLAY

REV A



POWER CHART			
IC	DEVICE	+5V	GND
1, 2	CD4042	16	8
3,4,5,6	CD4056	16	8
7	74C922	18	9

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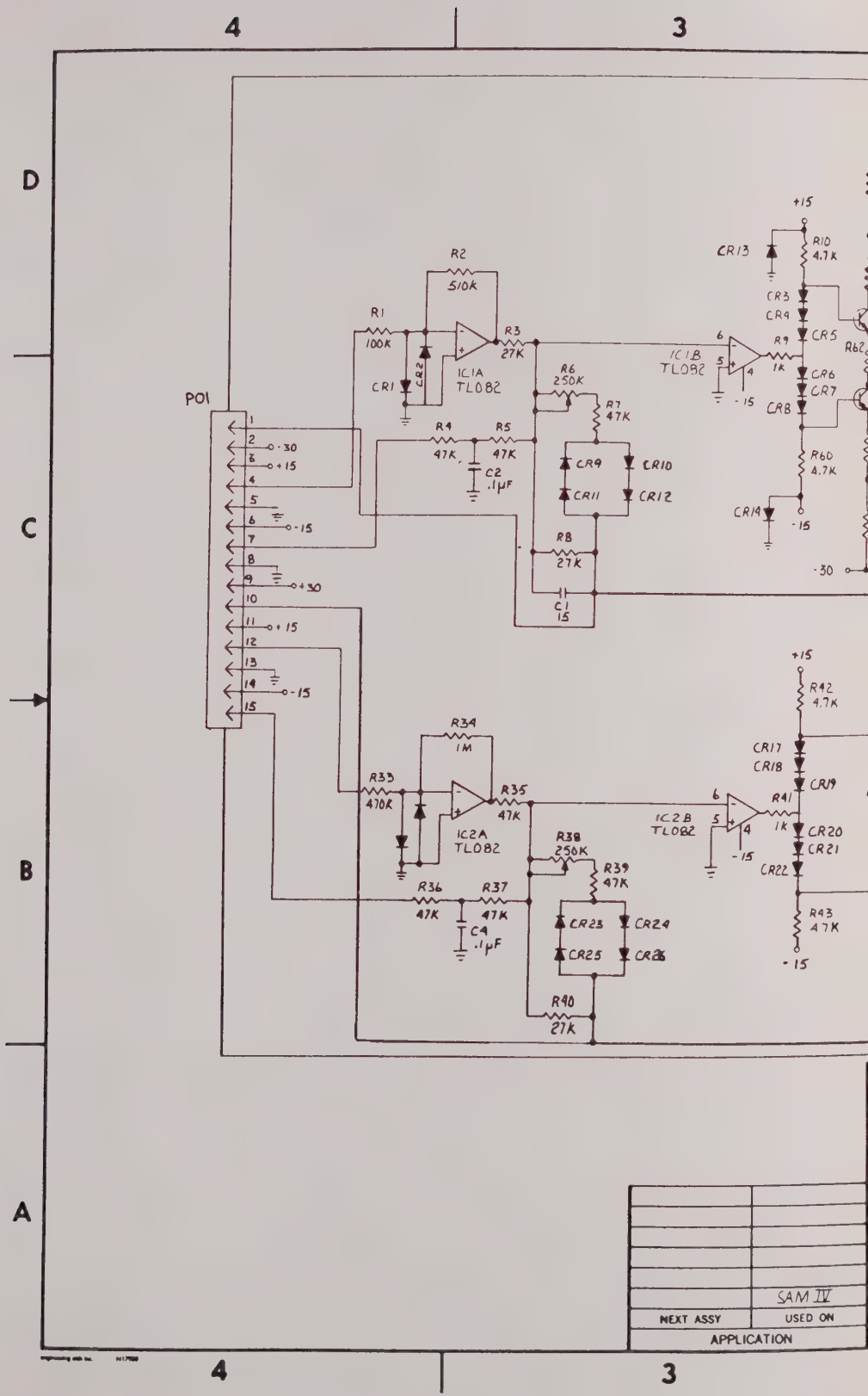
MATERIAL:	WAVETEK INDIANA		
	SCHEMATIC DIAGRAM, LIQUID CRYSTAL DISPLAY PC BOARD		
FINISH:	DRAWN BY G.L. RADER	SCALE —	DATE 8-14-81
	CHK'D	DATE	DRAWING NO C1290-02
ARTWORK #	RELEASED BY	DATE 1/21/82	

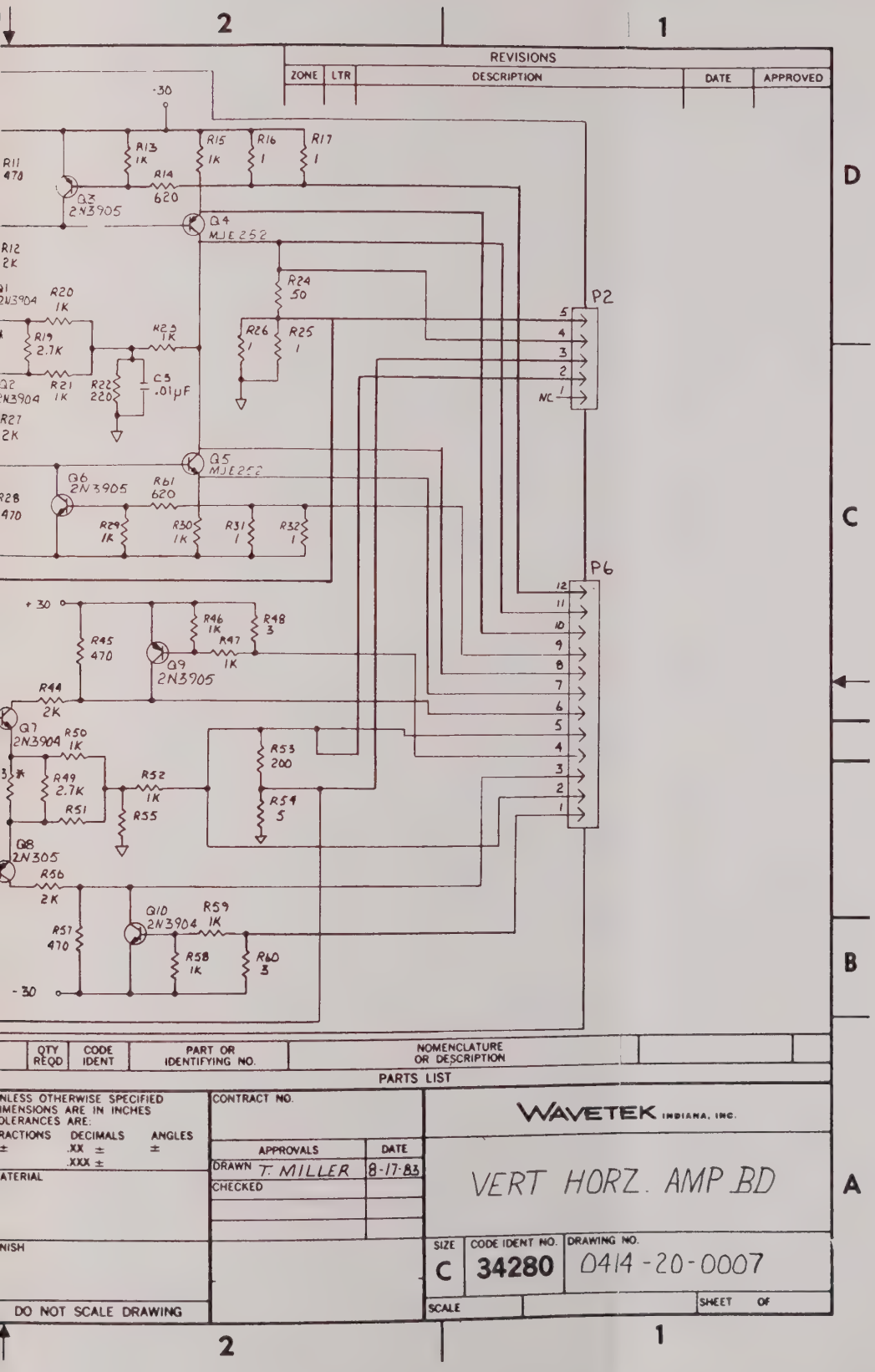
TOLERANCE:
DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED

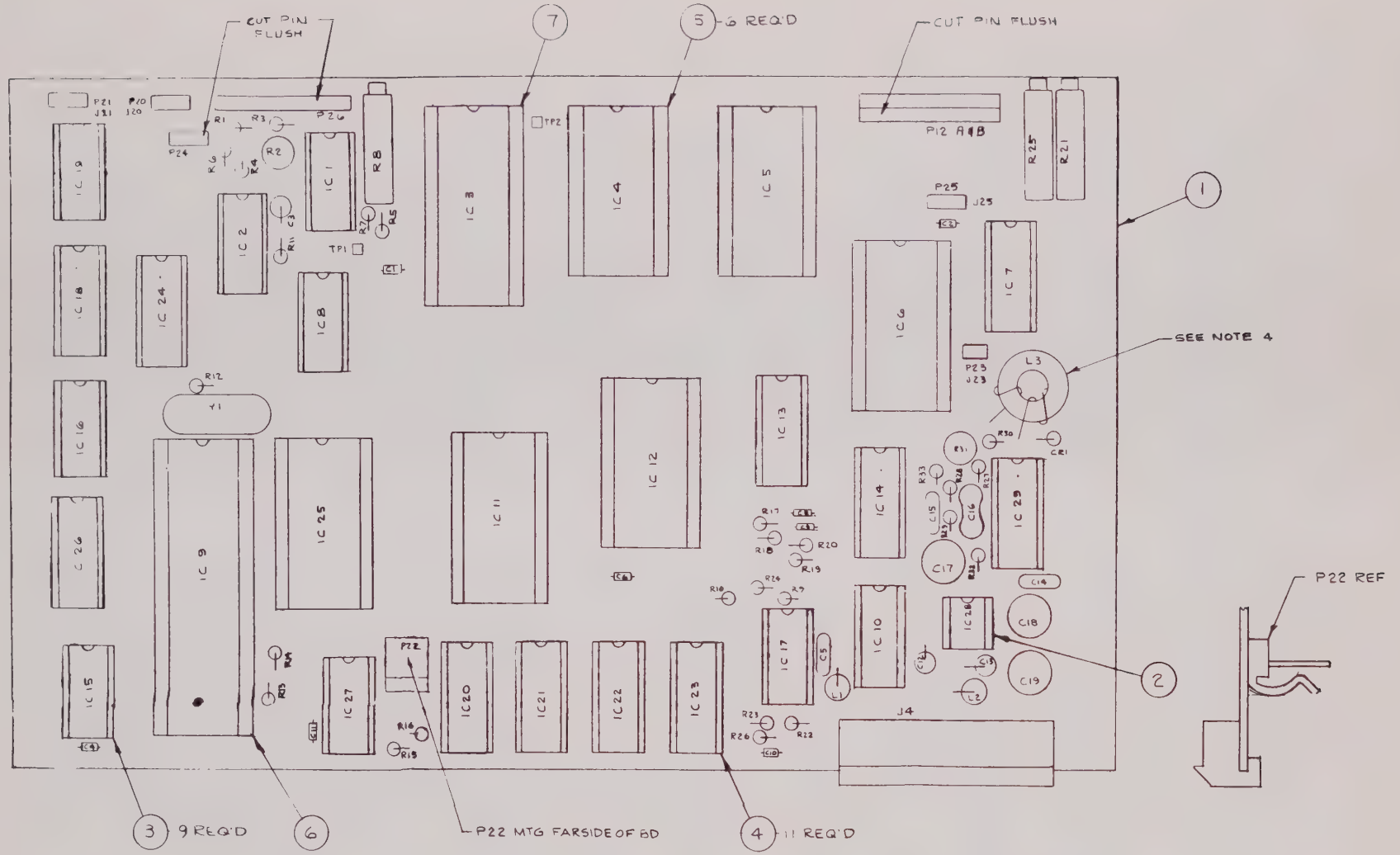
NO.	DESCRIPTION	BY
B	D-1029 3-20-84	WP
A	D-084	WP

REVISION

0014-20-9002


4
3
D
C
B
A
P01
R1
100K
R2
510K
R3
27K
IC1A
TL082
CR1
CR2
R4
47K
R5
47K
C2
.1μF
R6
250K
R7
47K
CR9
CR10
CR11
CR12
R8
27K
C1
15
IC1B
TL082
CR13
R10
4.7K
CR3
CR4
CR5
R9
1K
CR6
CR7
CR8
R60
4.7K
CR14
R62
+15
-15
-30
+30
R34
1M
R33
470K
R35
47K
IC2A
TL082
R36
47K
R37
47K
C4
.1μF
R38
250K
R39
47K
CR23
CR24
CR25
R40
27K
IC2B
TL082
R41
1K
CR17
CR18
CR19
CR20
CR21
CR22
R42
4.7K
R43
4.7K
SAM IV
NEXT ASSY
USED ON
APPLICATION


2
1
REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED
D
C
B
A
+30
-30
R11 470
R12 2K
R13 1K
R14 620
R15 1K
R16 1
R17 1
Q3 2N3905
Q4 MJE252
R19 2.7K
R20 1K
R21 1K
R22 220
R23 1K
C3 .01µF
R24 50
R25 1
R26 1
P2
5
4
3
2
1
NC
R27 2K
R28 470
Q5 MJE252
Q6 2N3905
R29 1K
R30 1K
R31 1
R32 1
R61 620
P6
12
11
10
9
8
7
6
5
4
3
2
1
R44 2K
R45 470
R46 1K
R47 1K
R48 3
Q9 2N3905
Q7 2N3904
R49 2.7K
R50 1K
R51
R52 1K
R53 200
R54 5
R55
Q8 2N305
R56 2K
Q10 2N3904
R57 470
R58 1K
R59 1K
R60 3
QTY REQD
CODE IDENT
PART OR IDENTIFYING NO.
NOMENCLATURE OR DESCRIPTION
PARTS LIST
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS ±
DECIMALS .XX ± .XXX ±
ANGLES ±
MATERIAL
FINISH
DO NOT SCALE DRAWING
CONTRACT NO.
APPROVALS
DATE
DRAWN T. MILLER 8-17-83
CHECKED
WAVETEK INDIANA, INC.
VERT HORZ. AMP BD
SIZE C
CODE IDENT NO. 34280
DRAWING NO. 0414-20-0007
SCALE
SHEET OF



NOTES

1. FOR PART'S LIST SEE 1110-00-9008
2. SCALE 2:1
3. WHEN INSTALLING Y1, MAINTAIN .03 MIN. DISTANCE BETWEEN BOTTOM OF COMPONENT & P.C. BD
4. CENTER L1 WITH HOLE ON BOARD AND MOUNT WITH HOT MELT GLUE.

REVISIONS			WAVETEK
	ECN'S	BY	
A	D030	DLR	ASSY DWG, P.C BOARD PROCESSOR
B	D051	TJM	
C	D1012		
D			DRAWN BY: N GAY; DATE: 1-8-82; NUMBER: 0012-20-9004
E			APP'D

MICROPROCESSOR BOARD THEORY OF OPERATION

1. SCOPE
   This specification consists of the requirements and design characteristics of the Processor Board (PB) which is used on the Sam IIID and Sam IV systems.

2. SCHEMATIC
   The schematic diagram for this board is drawing number 0014-30-9005 (D1390-05).

3 FUNCTION DESCRIPTION
   This board contains (11) separate circuits: Central Processing Unit and Decoder (CPU/D), Read Only Memory (ROM), Random Access Memory (RAM), Frequency Measurement (FM), Programmable Analog Control (PAC), Analog Input (AI), Multiplex Signal Input, (MSI), Sense and Liquid Crystal Write Function (S/LCD), Band Rate Generator (BRG), Diagnostic Testing (DT), and Power Supply (PS).

3.1 CENTRAL PROCESSING UNIT AND DECODING (CPU/D)
   The CPU/D consists of the microprocessor along with that associated hardware required to provide the address and 'N' line decoding. It is assumed the one has reviewed the "User Manual for the CDP1802 Cosmac Microprocessor" #MPM-201B prior to reviewing this specification. All error flags are used as inputs and the Q is utilized as an output. All transactions are handled by the CPU/D circuit.

3.2 READ ONLY MEMORY (ROM)
   The ROM contains all of the instructions which are necessary to perform the various tasks of the Sam IIID and Sam IV. The total capacity is 256 x 8.

3.3 RANDOM ACCESS MEMORY (RAM)
   The RAM is used to provide temporary storage of information while performing the various tasks of the IIID and SAM IV. The total capacity is 128 x 8.

3.4 FREQUENCY MEASUREMENT (FM)
   The FM Circuit is used to measure the frequency of the Sam IIID and Sam IV which provides an output to the Liquid Crystal Display (LCD).

3.5 PROGRAMMABLE ANALOG CONTROL (PAC)
   The PAC circuit is used to provide a means for the microprocessor to control the frequency of the IIID and Sam IV by providing on analog voltage via processor control.

3.6 ANALOG INPUT (AI)
   The AI Circuit provides a means to sense external analog inputs and interface them to the processor for interrogations.

3.7 MULTIPLEX SIGNAL INPUTS (MSI)
   The MSI consists of (7) individual inputs which must be monitored and selected when the processor requests the input.

3.8 SENSE AND LIQUID CRYSTAL WRITE FUNCTION (S/LCD)

The S/LCD circuit provides the processor with vital information of various parameters in the Sam IIID and Sam IV. The LCD circuit interfaces the processor to the Liquid crystal Display in order to indicate an ouput response for the Sam IIID and Sam IV.

3.9 BAUD RATE GENERATOR (BRG)

The BRG is used to provide an interface to interrupt the normal activities of the processor and address another activity, in this case the activity is RS232 service.

3.10 DIAGNOSTIC TESTING (DT)

The DT Function is used to provide a means for the operator to test the Sam IIID and Sam IV without removing the board at a system level.

3.11 THE POWER SUPPLY

The power supply is used to provide a high efficiency regulator in order to increase the operating time when using a battery. The power supply consists of two parts (1) + 5 Volt and (2) - 5 Volts (RS232 only).

4. CIRCUIT DESCRITION

4.1 CENTRAL PROCESSING UNIT AND DECODING (CPU/D)

The CPU/D requires a master clock which consists of 2 MHz Crystal (YI) and Resistor. In order to insure that the processor begins at address $ 000 a delay circuit is used which consists of IC2D, C3 and R11. The C3 and R11 provide a delay of 200 Msec. When power is applied, C3 looks like a short circuit and causes Pin 11 to be at a zero state. C3 continues to charge to its maximum supply voltage (+5) then IC2D goes to a logic 1 state. Terminal assignments for the 1802 microprocessor (figure 1) are provided for reference only. Pins 35 and 7 on IC9 (microprocessor) provide the Memory Write and Memory Read signals which are used for added decoding. Pins 25 through 32 on IC9 provide the memory address which in turn goes to IC25 for decoding and latching of the high byte of the instruction cycle when TPA (Pin 31) occurs. IC25 provides a method to increment memory in two basic chunks, and provides a Chip Select (CS) for the RAM and ROM which is used in the Sam IIID and Sam IV. Pins 17 through 19 are the 'N' lines which go to IC24 for particular decoding when an output or input instruction is desired by the CPU. The balloons at the output of IC24, pins 5,6,7 and 12 refer to the software instruction labels such as Output 1 or Input 2. The data bus consists of Pins 8 through 15 on IC9. The Error flags are used to provide direct inputs to the processor. EF1 is used to detect the mode for the PIX/SND Switch. EF3 is used to detect the Program/Manual Mode. EF4 and the Q output are used to handle the RS232 interface. SC0, SC1 and INT are used in conjuction with the EF4 and Q combination concerning the RS232 interface.

4.2 READ ONLY MEMORY (ROM)

The ROM (IC6) consists of 256 word x 8 bit on 2048 memory locations of Read Only Memory. The entire program is located in this ROM including the diagnostic package. ROM 1 on IC6, Pins 18 and 20 provide a means to select this chip. ROM occupies the space from $000 to $8000. Expansion to 4096 memory locations is provided if desired.

4.3 RANDOM ACCESS MEMORY (RAM)

The RAM (IC5) consists of 128 word x 8 bit static memory locations. RAM on IC5 pins 10,11, and 14 provide a means to select this chip. The RAM occupies the space from $8001 to $FFFF.

4.4 FREQUENCY MEASUREMENT (FM)

The FM circuit consists of IC 20,21,22,23,11,12 and IC27B. IC20 through IC23 are synchronous programmable 4 bit binary counters. The 'Window Concept' is employed. The frequency to be measured is inputed on Pin 2 of IC20 through 23. A digital controlled pulse (Window) is provided at the 'TE' input of IC20 , Pin 10. The window is exactly 16.8 Msec. Assume a frequency (FS) of 2.00 MHz as an input to IC20, Pin 2. The period P = 1/F = .5 x 10 -6 sec and the TE input will be high for a period of 16.8 Msec. The total count (Tc) will be equal to the TE input divided by the period of the Frequency (FS) input.

Therefore:

$$Tc = \frac{TE}{P} = \frac{16.8 \text{ Msec}}{.5 \times 10^{-6} \text{ sec}} = 3.36 \times 10^4 \text{ counts } (\$8340)$$

This is the count which will be stored in the four counters. The count is directly connected to IC11 and IC12 which are 8 bit Parallel Output Tri-State Ports. IC11 contains the MSD ($83) and IC12 contains the LSD ($40). The processor will activate a 'Input 2' (IC11-13) and 'Input 3' (IC12-13) in order to transfer the data from IC20 throught 23 to the Data Bus. It should be noted that IC27B insures that syncronization will be provided between the Processor, Window and Input Frequency. IC27B-9 is the 'Data' Input and IC27B-11 is the 'Clock' Input. Pin 10 on IC27B is the 'Window Inhibit' (WI) which is used to 'halt' the measurement of frequency. The processor monitors the window and knows when a measurement is in process. Once the measurement is completed, and the numbers are transferred, the processor will reset the counters to zero via Frequency Reset (FR) on Pin 1 of IC20 throught 23.

4.5 PROGRAMMABLE ANALOG CONTROL (PAC)

The PAC consists of IC13, 14 and 17. IC13 and 14 is a complete voltage-output 8 Bit digital-to-analog converter, including output amplifier, full microprocessor interface and precision voltage reference. Pin 10 on IC13 and IC14 is the chip select to transfer data from the processor to IC17B and IC17C. IC17B and C are voltage followers. IC13 is the 'Course' adjust DAC which has a label of 'DAC1' and IC14 is the 'Fine' adjust DAC which is labeled as 'DAC2'. Since the output voltage at J4-7 is a function of frequency it is very important to have the maximum amount of control of the DC voltage. DAC1 and DAC2 both provide an output of 10 mV/bit resolution. The maximum output per DAC is $FF (255) Bits x 10 mV/bit = 2.55 Volts. 17, C8 and R18 is a filter as well as an attenuator for DAC1. R24 and R25 provide feed back for the amplifier IC17B. R21, R22 and R23 provide the offset for IC17B. Assuming a typical gain of IC17B of 1.55, R14 will provide a typical output offset of 6 Volts. This offset is required in order to interface to the main driver amplifier which is located on the main mother board. Again assuming a typical gain of 1.55, DAC1 will have a transfer function of 15.5 mV/bit. The filter and attenuator for DAC 2 consists of R20, C9 and R19. Assuming the same gain, DAC 2 will have a transfer function of 0.320 mV/bit. R26 and C10 provide additional de-coupling for the voltage prior to the main driver.

4.6 ANALOG INPUT (AI)

The AI input consists of IC3 and IC4. IC3 is a monolithic CMOS device with an 8 Bit analog-to-digital converter, 8 channel multiplexer and microprocessor compatible control logic. IC4 is a prallel 8 Bit mode programmable COS/MOS, input/output port which is configured as an output port. The selection of the analog input is determined by the 'N' line selection of IC3, Pins 23,24, and 25. DO through D2 (IC4) are reserved for this selection via the microprocessor when an 'output 1' is performed. D3 and D5 are used for the Frequency Measurement Function and D6 is used for the Hum Select function. D7 is not used at this time. IC3 Pin 9 is the Chip Enable and is selected via and 'Input 1' instruction. Conversion occurs at a rate determined by the clock at IC3 Pin 10 which is 500 KHz.

4.7 MULTIPLEX SIGNAL INPUTS (MSI)

The MSI consists of IC1A,B and D. IC3 has a maximum capacity of 8 inputs, only 5 are utilized for the Sam IIID and Sam IV. A particular input channel is selected by using the address decoder. Table 1 shows the input states needed for the address lines to select any channel in IC3. Input number one (IN1) is used for Signal Level. The detected signal level enters the processor board via P26-1. IC1A is a Gain/Slope Amplifier with R1,R2 and R3. IN2 is used for Hum Level. The detected level enters the processor board via P26-2. IC1D is voltage follower configuration providing buffering for IC3. IN3 is the attenuator setting and IN4 is the battery status. The temperature level is IN5, and consist of IC1B and remote temperature sensor,T. T provides a constant current source to the 1K (R6) resistor which goes to the non-inverting input of IC1B. Gain is provided by R5 and R4 and offset calibration is provided by R7 and potentiometer R8. Transfer functions and normalization curves will be found under circuit specifications.

4.8 SENSE AND LIQUID CRYSTAL WRITE FUNCTION (S/LCD)

The S/LCD consists of IC7 and IC15. IC7 is used as a sensing element in order to determine the status of two functions (1) Window and (2) Keyboard Data. The Window Function is generated at the Baud Rate Timing Circuity. The processor circuit senses the Window time in order to make the frequency measurement calculation. The keyboard data signal is used to tell the processor that a key has been depressed and a service request is desired. The LCD Write Function consists of IC15B, C and A along with IC8F. When an "Output 4" occurs, it is necessary to determine if the poscessor should Read or Write from the I/O Ports. If the instruction is an "Input 4", then a Memory Read (MRD) will take place which means Data will be read from Memory and deposited to the Liquid Crystal Display Output Digits. If the instruction is an "Input 4" then a Memory Write Signal will cause IC7 (4 Bits) and Keyboard (4 Bits) to be read by the Processor.

4.9 BAUD RATE GENERATOR (BRG)

The BRG consists of IC16B (Divide by two), IC27 and 28 (Window Timing Circuit), IC18 and 19 (Baud Rate Timing Circuit), IC2B, 16A (Syncronization for Processor and Baud Rate Timing).

IC16B receives the Clock Signal from the crystal and divides the Frequency by two. IC26 is a Binary Counter with a maximum count of 16384. Each Clock Input is 1 usec leading to a count of 16384 usec or 16.384 Msec. Since this is the maximum capacity of the Counter IC26, no reset is required to zero the Counter. This provides the standard reference timing for the Frequency Window. IC27A provides a symetrical Output at this specified timing slot. This Window serves two purposes. (1)a Window for frequency measurement and (2) a Display Frequency (DF) for the Liquid Crystal Display Board. IC26 also provides an additional output every 2 usec or 500 KHz. This is used to provide a clock for the A/D Converter along with a Clock for the Baud Rate Generator Circuit.

The Baud Rate Generator Circuit consists of IC18 and 19. This circuit is configured in such a manner as to provide an output at a rate of 1.8 kHz at Pin 13 of IC19. This signal is fed to (IC16A-3) the Clock Input and awaits the confirmation 'Data IN' pulse from IC2B-4 to syncronize the Processor to the Baud Rate Generator. This final Output Signal is connected to the INT Signal of the Processor in order to provide a Clock for the RS232 interface. J21 provides a means to disable the INT Signal if desired.

4.10 DIAGNOSTIC TESTING (DT)

The DT function is activated when J20 Jumper is connected between Pins 2 and 3. The processor senses EF2 and if EF2 should go low, it jumps to the diagnostic sub-routines. A particular sub-routine is selected by the position of EF1 (PIX/SND Switch) and EF3 (PIX/MAN Switch) as shown in Table 2. Figure 3 shows the keyboard configuration which is used on the Sam IID and Sam IV. It should be noted that the keyboard information required only (4) four bits of an (8) eight bit word. The least (4) four bits were chosen for keyboard information and the remaining upper four (4) bits for additional functions. The lower left side of each key indicates the HEX code required of the last (4) four bits in order to determine key identification for software. The dollars sign ($) signifies the HEX notation.

4.11 POWER SUPPLY (PS)

There are two power supplies used on the Processor Board consisting of +5 Volt and -5 Volts.

4.11.1 +5 Volt Switcher Supply

The +5 Volt switcher supply consists of IC29 along with its associated parts. IC29 receives its power from the battery (BT) via an inductor and capacitor. This LC network provides decoupling for IC29 by providing a high impedance out to the lines going to the battery. R31 is used to adjust the 5 Volt Output under load. L3 and C17 through C19 provide the filter which is necessary for the +5 Volt Output. A jumper plug is provided (J23) in order to be able to check the 5 Volt Switching Power Supply under load prior to connecting the Processor circuitry.

4.11.2 -5 Volt Supply

The -5 Volt Supply IC28 is used on the Liquid Crystal Display Board for the RS232 interface. The Supply Output is dependent on the supply input because it inverts the positive voltage input. C12 and C13 are used to provide added decoupling for IC28.

5. CIRCUIT SPECIFICATIONS

Power Supply Voltage is to be adjusted as per specification for Sam IIID and Sam IV.

SAM III PROCESSOR BOARD AND LCD BOARD TEST AT SYSTEM LEVEL

NOTE:

THE SAM SHOULD BE ON FOR AT LEAST 15 MINUTES PRIOR TO MAKING ANY ADJUSTMENTS.

Set up front panel as follows:

Power	off
Function	SLM
Gain	Cal.
PGM/MAN	MAN
AFC	off
PIX/SND	SND
Light	off
Attenuator	+15 - +25 scale

I DIAGNOSTIC TEST

1.a Turn power on. With DVM measure the voltage at P26-9, this should be +5.00VDC. If not, adjust R31 on the processor for +5VDC ±0.

1.b The liquid crystal display (LCD) will be sequencing alphanumerics from right (LSD) to left (MSD) as follows: 0,1,2,3,4,5,6,7,8,9,L,H,P,A,-, blank. The decimal point will be on at all times throughout test.

2 Place PGM/MAN switch to PGM. The display will blank except for the decimal. Depress the following keys on the keyboard and observe for proper display. The 2nd digit from the right will be the only digit displayed when the keys are depressed.

KEY	LCD DISPLAY	KEY	LCD DISPLAY
1	1.	9	9.
2	2.	Freq.	L.
3	3.	CHN	H.
4	4.	CHN (HRC	P.
5	5.	Next	A.
6	6.	.	-.
7	7.	CLR	.
8	8.	0	0.
9	9.		

3. Place PIX/SND switch to PIX position. Depress key 1. A four digit number will display. Adjust R21 on the processor board for an LCD display of 455.

4. Depress key 2. Adjust R25 on the processor board for a display of 000.0 and observe the signal on an 1801 or equivalent sweep generator and oscilloscope connected to the video output of the Sam III. The 1801 should be set up for a 50 MHz sweep width and the frequency should be set so you can observe 0 MHz to +50 MHz at +20 dBmV on the scope. Adjust R25 so the signal goes through 0 MHz and keep adjusting until the signal reaches -30 MHz. The LCD will still display 000.0.

5.a Place the PGM/MAN switch to manual. Using an MC-50 preferably connect the RF output of the generator to the RF input of the Sam IIID. Adjust the MC50 for 150 MHz at +20 dBmV. Slowly tune until the meter peaks. LCD should display 127.0 ±. If not adjust R39 on the Sam IIID mainboard.

5.b Set generator to +10 dBmV. The LCD should display 094.0 ±1, if not adjust R2 on the processor board.

5.c Set generator to +30 dBmV. LCD should display 160.0 ±1, if not repeat steps 5a and 5d until proper readings are obtained.

II MANUAL OPERATION

1. Turn off power and move P20 jumper from pins 1-2 to 2-3.
2. Turn on power. Rotate tuning knob to both extremes. At maximum counterclockwise position, LCD will display 0.0 and at maximum clockwise position LCD will display greater than or equal to 460.0 MHz.
3. Set attenuator to +15 - +25 range. With the MC-50 connected to RF in on the Sam III at 150 MHz and +20 dBmV, slowly tune frequency until meter peaks. Meter shall read +20 dBmV, if not adjust calibration set potentiometer on front panel for +20 dBmV on meter.
4. Connect a short cable from the cal. out on the Sam III front panel to RF in on the Sam III front panel and peak the meter. The meter should peak at +20 dBmV and the LCD will display 150.0 ±.1.
5. Tune the Sam to a known audio source and connect antenna or cable to the Sam. The audio should be relatively noise free, with no distortion.

III TRACKING ACCURACY

Place the Sam PGM/MAN switch to PGM. Depress 150.0 frequency on the keyboard. Set the attenuator at +15 - +25 scale. Connect MC-50 to the RF input on the Sam at 150.0 MHz and at +20 dBmV. With AFC off the signal should be at +20 dBmV on the Sam, if not adjust T1 on the mainboard until the meter peaks. With AFC on the needle should not move at all, if you try to repeak the Sam using the fine tune adjust on the MC-50 the frequency should not move more than ±.03 MHz. If the unit changes more than this, turn AFC off and peak the MC50 at 150.0 MHz, the needle should read +20 dBmV on the meter. Turn AFC on and peak the RF tuning caps on the front of the RF assembly. Peak the tuning caps on the back of the RF first.

IV TESTING PROGRAM MODE

Place PGM/MAN switch in PGM. AFC should be on.

	PRESS	LCD WILL DISPLAY
1.	1, CHN	41.2
2.	2, CHN	59.7
3.	NEXT	65.7
4.	2, CHN HRC	58.5
5.	NEXT	64.5
6.	4,0, CHN	323.7
7.	NEXT	329.7
8.	4,0, CHN/HRC	322.5
9.	NEXT	328.5
10.	6,0,CHN	443.7
11.	NEXT	449.7
12.	6,0,CHN HRC	442.5
13.	NEXT	448.5
14.	Place PIX/SND Switch to PIX	444.0
15.	NEXT	Blank
16.	1,CHN	45.7

PC BOARD SHC DISPLAY

SELECTED ANALOG CHANNEL	ADDRESS LINE A	B	C	DESCRIPTION
IN0	L	L	L	SPARE
IN1	L	L	H	SIGNAL LEVEL
IN2	L	H	L	HUM
IN3	L	H	H	ATTENUATOR
IN4	H	L	L	BATTERY
IN5	H	L	H	TEMP
IN6	H	H	L	SPARE
IN7	H	H	H	SPARE

TABLE 1

Selected Diagnostic Routine	EF1 PIX/SND	EF3 PGM/MAN	Keyboard Entry
LCD Display Check	SND	MAN	N/A
Keyboard Entry Check	SND	PGM	All Keys
C A L I B R A T I O N F U N C T I O N M O D E S			
Signal Slope (R2)	PIX	MAN	N/A
High Frequency (R_{21})	PIX	PGM	1
Low Freq Adjust (R25)	PIX	PGM	2
Temp Adjust (R8)	PIX	PGM	3
Reserved For Future	PIX	PGM	4 - 9

TABLE 2

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SELECT N LINE	$\overline{MRD}$	$\overline{MWR}$	DESCRIPTION
1	-	X	A/D Convertor Data to BUS [IC3]
1	X	-	Control Data From BUS [IC4]
2	-	X	Frequency [MSD] Data to BUS [IC11]
2	X		DAC 1 Control Data From BUS [IC13]
3		X	Frequency [LSD] Data to BUS [IC12]
3	X	-	DAC 2 Control Data From BUS [IC14]
4		X	Window and Keyboard Data to BUS [IC7 & P12-16]
4	X	-	LCD Control Data From BUS [P12 - 10]

TABLE 3

DATA BUS BIT	IC4 PIN	DESCRIPTION
0	4	Analog Channel Select A
1	6	Analog Channel Select B
2	8	Analog Channel Select C
3	10	Start Conversion Pulse
4	15	Frequency Reset Pulse
5	17	Window Inhibit Pulse
6	19	Hum Relay Pulse
7	21	Spare

TABLE 4

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TABLE 5

CONNECTOR	PIN	FUNCTION	LOGIC (VOLT)	MISCELLANEOUS
P5	1	SIGNAL LEVEL	(1)	SL
P5	2	HUM LEVEL	(1)	HL
P5	3	SPARE		
P5	4	SPARE		
P5	5	BATTERY STATUS	(1)	BS
P5	6	GROUND		
P5	7	SPARE		
P5	8	ATTENUATOR SENSE	(1)	AS
P5	9	+5Volt		
P5	10	HUM RELAY OUTPUT	12	HR
J4	1	GROUND		
J4	2	LAMP POWER		LP
J4	3	PLUS SIX VOLTS		+ 6V
J4	4	PLUS TWELVE VOLTS		+12V
J4	5			
J4	6			
J4	7			
J4	8	SPARE		
J4	9	BATTERY TERMINAL		BT
J4	10			
P22	1	FREQUENCY INPUT		
P22	2	GROUND		
J23	1	SWITCHER PLUS FIVE		
J23	2	LOAD OUTPUT		

NOTE: (1) See Analog Transfer Curves

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CONNECTOR	PIN	FUNCTION	LOGIC (VOLT)	MISCELLANEOUS
P12	1	LCD GROUND	- - -	- - - - - - - -
P12	2	LAMP POWER	- - -	- - - - - - - -
P12	3	SPARE	- - -	- - - - - - - -
P12	4	DISPLAY FREQ ONE	5	DF1
P12	5	SERIAL DATA OUT	5	SDO
P12	6	SERIAL DATA IN	5	SDI
P12	7	DATA BUS ZERO	5	DØ
P12	8	DISPLAY FREQ TWO	5	DF2
P12	9	DATA BUS ONE	5	D1
P12	10	OUTPUT FOUR	5	OUT 4
P12	11	DATA BUS TWO	5	D2
P12	12	MINUS FIVE VOLT	-	-5V
P12	13	DATA BUS FOUR	5	D4
P12	14	DATA BUS FIVE	5	D5
P12	15	DATA BUS SEVEN	5	D7
P12	16	INPUT FOUR	5	IN4
P12	17	PLUS FIVE VOLT	-	+5V
P12	18	DATA BUS SIX	5	D6
P12	19	DATA BUS THREE	5	D3
P12	20	DATA AVAILABLE	5	DA
J20	1	NORMAL MODE	5	J20-1 to J20-2
J20	2	DIAGNOSTIC SENSE	-	----------
J20	3	DIAGNOSTIC MODE	0	J20-2 to J20-3
J21	1	NORMAL	-	J21-1 to J21-2
J21	2	INTERRUPT SENSE	-	----------
J21	3	STANDBY MODE	-	J21-2 to J21-3

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Terminal Assignments for the RCA CDP1802 COSMAC Microprocessor

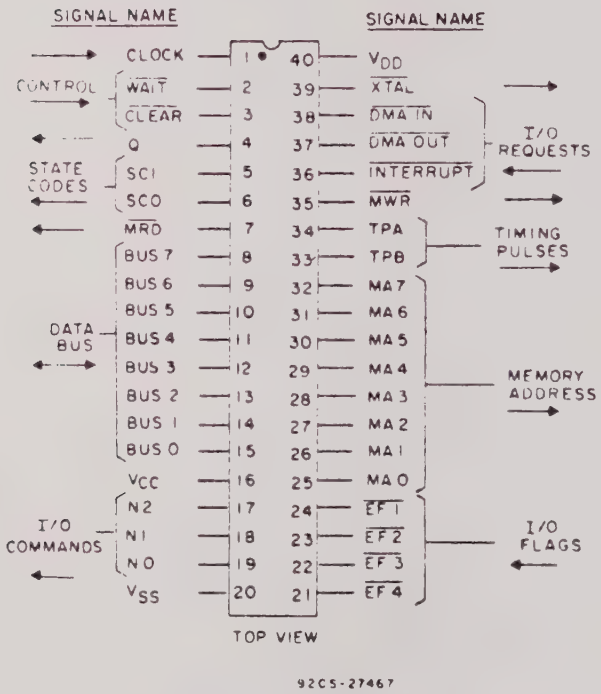


FIGURE 1

KEYBOARD CONFIGURATION

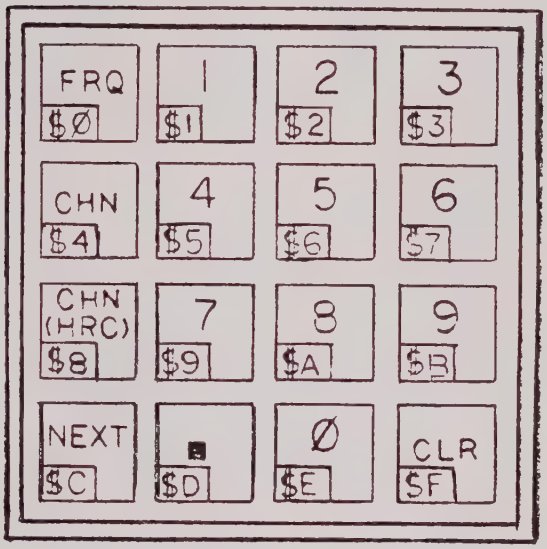
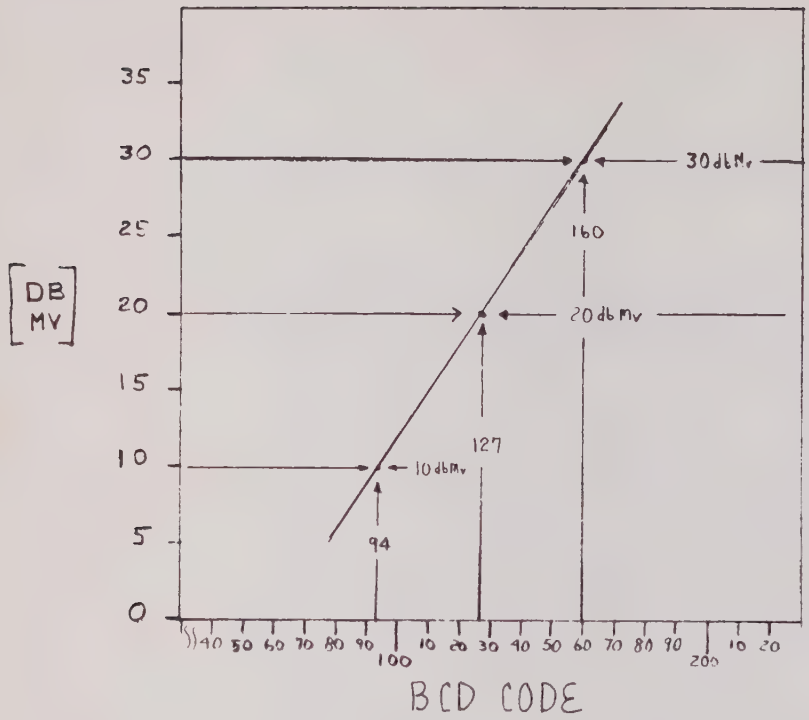


FIGURE 3



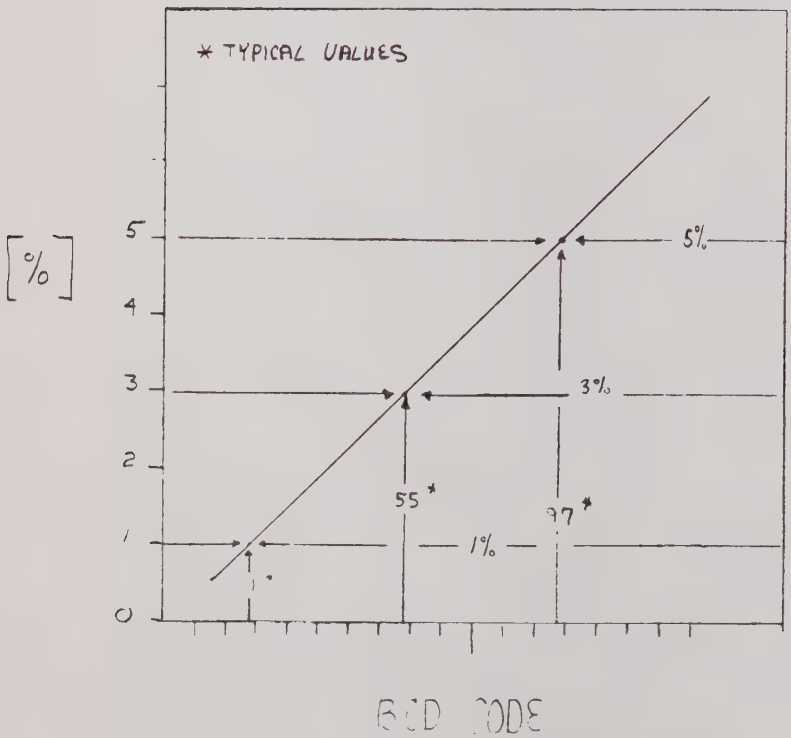
PLOT 1a

RF SIGNAL
VS
A/D CODE

$Y = 0.303 X - 18.48$

Y = DB MV

X = BCD CODE



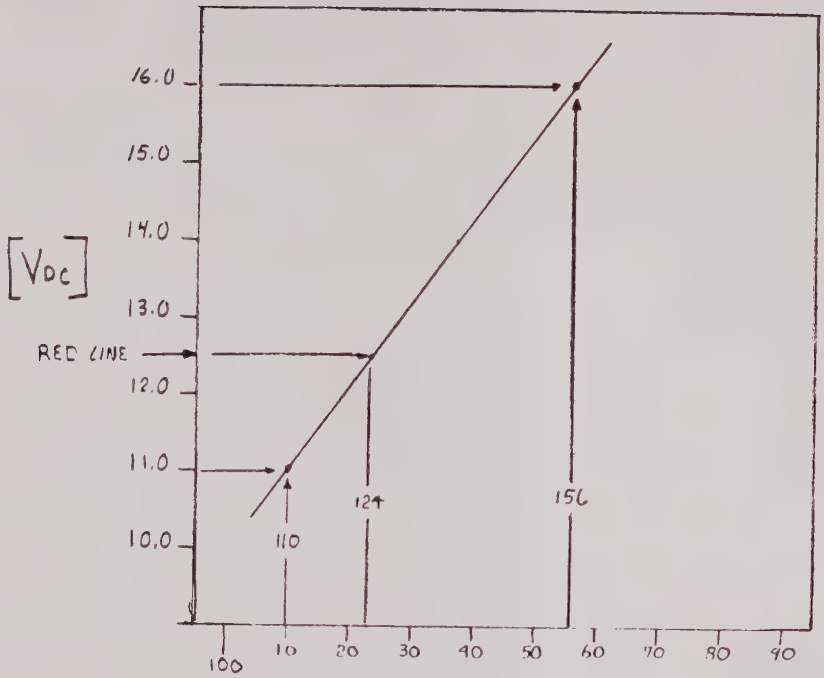
PLOT 1b

% HUM
VS
A/D CODE

$Y = .046 X + 0.54$

Y = %

X = BCD CODE



PLOT 1c

BATTERY
VS
A/D CODE

$Y = .109X - 0.942$

Y = VDC

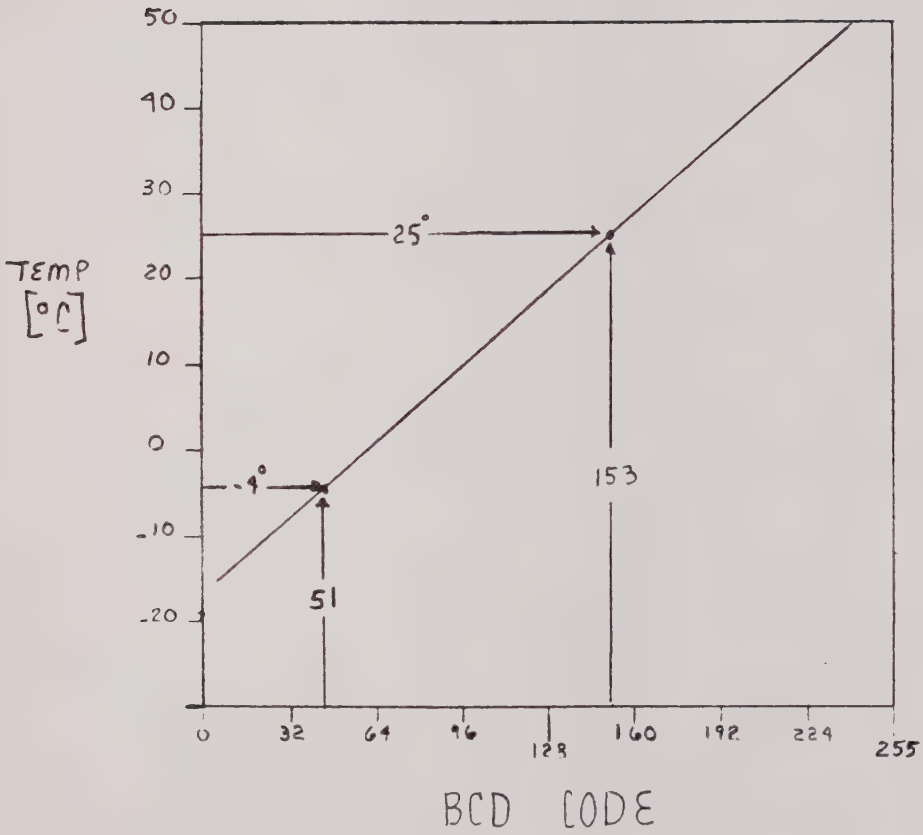
X = BCD CODE

ATTENUATOR POSITION [DB]	BCD CODE
-25 TO -15	144
-15 TO -5	160
-5 TO +5	176
+5 TO +15	192
+15 TO +25	208
+25 TO +35	223
+35 TO +45	239
+45 TO +55	255

PLOT 1d

ATTENUATOR
VS
A/D CODE

NOTE: BCD TO VOLTAGE CONVERSION FOR ALL PLOTS IS 19.6 mV/BIT $\therefore$ FF = 256 = 5.00 VDC.



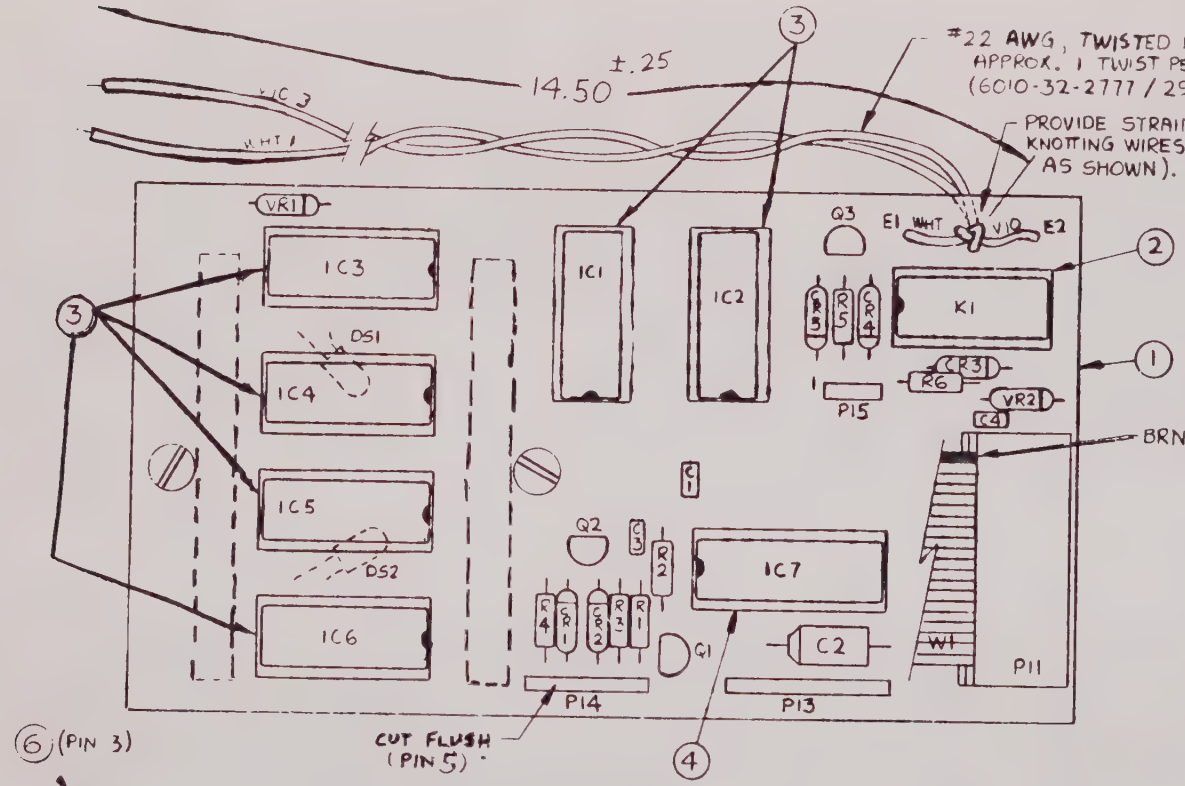
Plot 1e

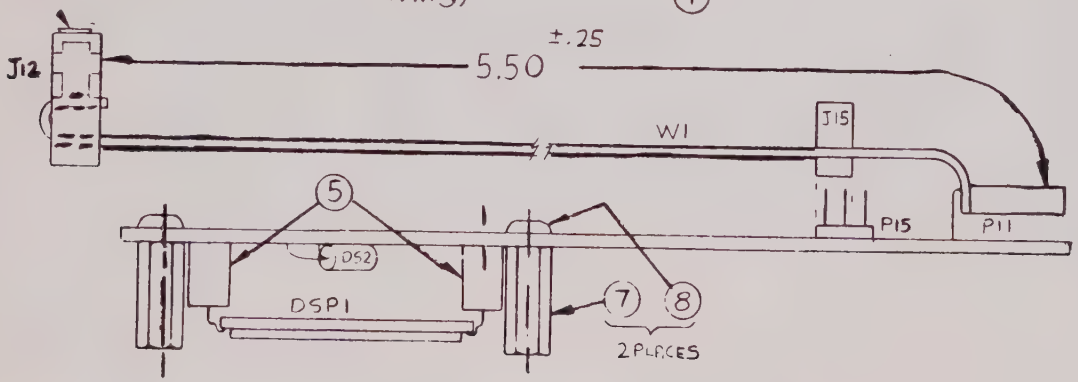
TEMP
VS
A/D CODE

$Y = .284\,X - 18.45$

Y = Temp °C

X = BCD CODE





NOTE:

1. FOR PL SEE 1110-00-9007

REVISIONS			WAVETEK
	ECN'S	BY	
A	D-1014	7-7-82	ASSEMBLY DRAWING, LIQUID CRYSTAL DISPLAY PC BOARD
B	C1029	9-10-82 WC	
C			DRAWN BY: G.L. RADER; DATE: 12-21-81; NUMBER: 0012-10-9011
D			
E			APP'D: [illegible] 1/27/82

LIQUID CRYSTAL DISPLAY BOARD THEORY OF OPERATION

1. SCOPE
   This specification consists of the requirements and design characteristics of the Liquid Crystal Display Board (LCD) which is used with the Sam IIID and Sam IV system.

2. SCHEMATIC
   The schematic diagram for the board is drawing number C1290-02/0014-20-9002

3. FUNCTION DESCRIPTION
   This board contains 3 separate circuits:
   - 3.1 Liquid Crystal Display (LCD)
     The LCD is used to display output information via the microprocessor. The LCD function is to display FREQUENCY in Megahertz.
   - 3.2 Keyboard Data Entry (KDE)
     The KDE is used to enter (Input) information via the microprocessor. The KDE's function is to enter pre-determined channel frequencies or on line frequency carrier entries.
   - 3.3 RS232 Interface (RS232)
     The RS232 is used to provide a remote means to communicate with the Sam IIID The RS232 consists of two (2) parts. The serial Input/Output circuit and the remote power on circuit. The RS232 can interface to a terminal or a telephone modem.
   - 3.4 Address Interface
     The address interface circuitry is used to provide a routine of instructions which provide the definition of the systems mode of operation by selecting the Chip Enable (CE) and appropriate address in order to achieve the desired results. The address circuitry orginates from the main processor board.

CIRCUIT DESCRIPTION

4.1 LIQUID CRYSTAL DISPLAY (LCD)

The LCD Consists of:

1. Liquid Crystal Display (DPS1)
2. LCD Driver Circuits
3. Latch/Decoder Circuits.

The information which is to be displayed is outputed to the data bus via the microprocessor. IC1 and IC2 inputs the data from the data bus and holds the information for display. The data is divided into two parts. (1) Binary Coded Decimal (BCD) Segment Code (D0-D3). (2) Digit Select (D4-D7) IC 3,4,5, and 6 are used as display drivers. Since all four IC's are identical, only one will be discussed in detail. IC3 receives the Binary Coded Decimal (BCD) Segment Code from IC1 and the Digit Select Code from IC2. IC3 contains the level shifter, Binary Coded Decimal (BCD) to 7 Segment Decoder and the display drivers. A display frequency input DF1 is provided in order to activate the liquid crystals with the proper phase relationships. A segment on DSP1 will be activated if the display frequency is 180 degrees out of phase with the display frequency input. The display frequency is a square wave at a frequency of 61 Hz. In order to provide a decimal point, it was necessary to add a display frequency bar (DF2). DS1 and DS2 provide a means to illuminate the Liquid Crystal Display (DPS1) at night and also provides increase residual ambient temperature for the crystals when used in colder environments.

4.2 KEYBOARD DATA ENTRY (KDE)

The KDE consists of IC7 which provides all the necessary logic to fully encode an array of SPST switches. An internal debounce circuit along with a data available (DA) output and on Chip Clock provide the power to encode a total of 16 key entries. As data is entered via keyboard, the data available (DA) output goes high and alerts the microprocessor of a new entry. The microprocessor will then select the Output Enable (OE) which will transfer the data from the keyboard encoding logic to the data bus for interrogation by the CPU of the microprocessor.

4.3 RS232 INTERFACE (RS232)

The RS232 Interface consists of two (2) parts. The serial input/output circuit and the remote power 'on' circuit.

4.3.1 SERIAL INPUT/OUTPUT CIRCUIT (SD1/SDO)

The SDI/SDO consists of Q1 and Q2. Data enters (SDI) the microprocessor via EF4 and exits (SDO) via the Q line. Since the microprocessor handles all the data and interfaces, the only requirement of the serial Input/Output is to transfer the signal levels from the RS232 connector which is a plus/minus level to a zero and one bit code.

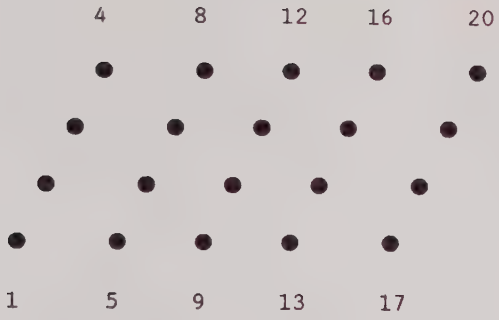
4.3.2 REMOTE POWER 'ON'CIRCUIT

The Remote Power 'ON' Circuit consists of K1 and Q3. When a positive signal is recived via Pin 8 on the RS232 connector, a closure will occur at terminal E1 and E2 which will by-pass the on/off switch on the Sam IIID/Sam IV and activate the microprocessor package. A data ready (DR) signal is provided for a modem on J19 - 20 via R6 on LCD Board. The type of modem being used, will determine which configuration the shorting jumper is in.

4.3.3 ADDRESS INTERFACE

The Address Interface provides a means to decode the address lines from the microprocessor and react when a particular address is sensed. There are two primary chip selects on the LCD Board. When the microprocessor desires to make a deposit to the liquid crystal, it addresses IC1 and IC2. When the microprocessor desires to receive information from the keyboard, it addresses IC7. The data bus provides the key information for the microprocessor to respond to commands or executions. There are a total of 8 bits (DO-D7) which are used to communicate. The LCD uses 4 bits (DO-D3) for coding the segments of the LCD and 4 bits (D4-D7) for coding the digits to be selected. The keyboard data requires only 4 bits (DO-D3) for identification of key depressed and 1 bit (D4) indicating that data is available (DA) for the microprocessor to interrogate. The decoding for the LCD and Keyboard is an 'Output 4' which defines the LCD and Keyboard to the microprocessor.

LCD SIGNALS



1 Ground	11 Data
2 0 (15V W/Lamp Test)	12 -10V
3 N/C	13 Data
4 5V Square Wave	14 Data
5 5V (Alternates W/Test 3)	15 Data
6 5V	16 5V
7 Data	17 5V
8 5V Square Wave	18 Data
9 Data	19 Data
10 Sync Pulse	20 0 (Goes High When Key Pushed)

SAM IIID REMOTE OPERATION CHECK

1) Place function switch to SLM mode.

2) Put PGM/MAN switch to PGM

3) With AFC on, set attenuator to +15 - +25 range.

4) Plug RT-1 into the Sam RS-232 connector.

5) Turn RT-1 on, the Sam IIID should come on and display 55.2.

6) Depress 1, then OPT on the RT-1, should display battery voltage on RT-1.

7) Depress 2, then OPT on RT-1, should display Hum, the reading should be less than or equal to 13.0.

8) Depress 3, then OPT on RT-1, should display the temperature-in Celcius.

9) Depress 4, then OPT on RT-1, should display the attenuator setting of the upper window of the Sam IIID. Rotate the attenuator through all steps and check each step with the RT-1.

10) Use an MC-50, set at 150.0 MHz and +20 dBmV output. Place the RF out of the MC-50 to RF in of the Sam. Depress 1, 5, 0 on the RT-1, then FREQ, should display +20 dBmV ±.6 dBmV.

11) Turn RT-1 off, the Sam IIID should shut off.

SAM III CALIBRATION

I. Power supplies
   1) Check +6 Vdc and +12 Vdc power supplies. Should be ± .1 Vdc
      a. Changing the value of R116 will adjust the +12 Vdc supply.

II. 3rd L.O.
   1) Must be in manual mode with no signal applied.
   2) Connect a pick-off loop to a frequency counter.
   3) Sample the frequency of T1 and adjust if needed to have a frequency of 35.05 MHz with AFC on.
   4) With AFC off adjust R73 for a frequency of 35.05 MHz.

III. 2nd L.O.
   1) All Sam III meters have a crystal controlled 2nd L.O.
   2) The 2nd L.O. frequency should be 414.25 MHz.
   3) Connect a cable from a frequency counter to the "F" connector on the bottom of the R.F. assembly. This is located nar the right hand corner of the R.F.

IV. R.F. Gain, Flatness, and Sweep Width
   1) Connect an I.F. cable from an 1801 sweep generator, R.F. out put, to the I.F. in input the mainboard of the Sam.
      a. The generator should be set for an output of +20 dB at 45.75 MHz
      b. Connect a cable from the "demod in" to "video vert." on the front panel.
      c. Place the unit in open-loop via S1 on the mainboard.
      d. Set the scope for an X-Y display with the horizontal out of the generator to the horizontal amp of the scope.
      e. Connect the vertical out to the generator to the vertical amp of the scope.
      f. Set the scope to .2 V per division,(DC coupled).
      g. Set the generator to 100 msec. sweep, time and sweep width for approximately 80 MHz.
      h. Adjust R7 (open loop gain) for a signal at approximately .1 V.
   2) Disconnect the I.F. cable from the sweep generator and replace it with the I.F. cable form the R.F. assembly.
      a. Connect the R.F. out cable from the generator into the R.F. in connector on the Sam.
      b. Place the Sam attenuator to +20 dBmV-mid scale position.
      c. Tune the generator to 150 MHz at +20 dBmV.
      d. Tune the Sam to 150 MHz at +20 dBmV.
      e. Peak all tuning caps and coils on the R.F. assembly starting with the one at the left front of the R.F.
      f. Adjust R7 again after this for 1 V signal. You should be observing an R.F. signal approximately 36 to 40 dBmV.
      g. Adjust R7 agin after this for 1 V signal. This finishes R.F. gain check.
   3) To check the flatness use your reference voltage of 1 V.

a. Start by tuning the Sam and the sweep generator together down in frequency. Watch the scope and observe the amplitude, it should not change more than ±.7 dBmV from 10 MHz to the top range of your meter.
b. Observe the sweep to also insure that the weep width goes down to -10 to -12 MHz and up past the top range of your meter plus about 12 MHz.

4) UHF Calibration
a. Check UHF Flatness by first switching the Sam into UHF. Connect the 1801 sweeper to the RF input of the Sam. Set a 1 V refference at 471 MHz, sweep up to 890 MHz. The signal cannot very more than +3 dB.
b. The flatness characteristics of the UHF L.O. are very different than that of the VHF L.O. therefore in some cases a UHF meter compensation resistor is needed. With the unit in closed loop peak up on a 150 MHz +20 dB signal from a MC50.
c. Use the calibration set pot to set the meter right at 20 dB. Remove the MC50 and connect the 1801 sweeper to the Sam.
d. With the 1801 in manual sweep to 150 MHz and set the variable attenuator of the 1801 so that the Sam meter reads exactly 20 dB. Switch the Sam into UHF and using the 1801 find the highest meter reading and the lowest meter reading between 471 MHz and 890 MHz. If these readings are within ±1.5 dB of the 20 dB refference, no compensation resistor is needed. If however the lowest UHF reading is not within 1.5 dB of 20 dB select a resistor of 1 M and place it in position R80. Repeat the a bove steps, being sure to reset the 150 MHz 20 dB reference. If the lowest UHF reading is still not within 1.5 dB of 20 dB, reduce the value of resistor R80. Make sure you check the highest UHF reading to see that it is not more than 1.5 dB greater than 20 dB. If you are unable to get the UHF readings within ±1.5 dB of 20 dB, the UHF L.O board requires work and must be sent to the factory for repair.

V. AFC
1) Connect the scope probe to IC9 pin 1, set the scope to 1 V per division.
2) Tune the Sam and 1801 sweeper to 150 MHz at +20 dBmV.
3) Tune MX1 (discriminator coil) blue coil for a symmetrical signal, and adjust the pink coil for maximum amplitude-may need to adjust the blue coil again.

VI. Integrator
1) Tune the Sam and the MC50 to 150.0 MHz at +20 dBmV.
2) Must be in closed loop. Connect scope probe to test point 1, pin 4 of IC3..
3) Put in closed loop and place the sweeper in manual sweep mode. Sweep through from no signal to a frequency maximum signal. The maximum signal condition should lower the response by .4 V difference

VII. Meter Tracking

1) Set the +10 dB gain potentiometer to calibration position and the calibration set potentiometer to midrange.
2) R84 will be approximately a 220 K ohm resistor.
3) Set the Sam attenuator to the +30 dBmV mid scale, and adjust R83 for a +20 dBmV reading on the left side of the meter movement.
4) Set the Sam attenuator to the +20 dBmV mid scale, and adjust R89 for a +20 dBmV scale reading.
5) Turn +10 dBmV potentiometer on the front panel all the way clockwise and adjust the Sam attenuator to +30 dBmV mid scale reading. Adjust R85 for a +30 dBmV reading.
6) Set the Sam attenuator to +40 dBmV mid scale reading and adjust R10 if necessary to make minor adjustment to low end. Go to the +20 dBmV attenuator setting a mid scale and check high end reading.

VIII. Peak Detector

1) R20 is selected to be approximately 22K to 39K ohm resistor.
2) Connect your MC-50 preferably (meter calibrator) out to the Sam R.F. in.
3) Tune your calibrator to 150 MHz at +20 dBmV.
4) Tune the Sam to 150 MHz and peak on the signal.
5) Turn TV modulation on, and the signal on the Sam should read +19.75 dBmV to +20 dBmV. If you do not have the reading in this window of range then change the value of R20.

IX. Hum

1) R50 is selected for hum to be 80K ±20K ohm.
2) Connect your hum source.
3) Tune the Sam to the frequency of the source.
4) Switch to hum. The needle will peg momentarily. The low level will read less than .5%, the next level will be 2% ±.25%, and the last level will be 4% ±.25%. Adjust R51 as needed to acheive these levels.

X. Analyzer

1) CR1 and R24 are selected for the analyzer circuit. CR1 is a IN914 diode, and R24 is typically between a 18K to 24K ohm resistor.
2) Adjust your scope for X-Y display, plug cable from the Sam horizontal to scope horizontal.
3) Connect the video vertical on the Sam to the vertical on the scope.
4) Set the scope to .5V per division.
5) Set the Sam function switch to analyzer and manual/sweep switch to sweep.
6) Set the sweep rate fully clockwise and dispersion fully clockwise on the Sam.
7) Adjust R25 for the noise level of .4V to .6V.
8) Adjust R39 DC level potentiometer for the lower peaks to be cut off.
9) Using your dispersion control should allow you to see 0 MHz to the top frequency your particular meter is specified for.
10) All spurs should be at least 20 dB down from your reference signal at +20 dB.

XI. S/N

1) Tune Sam to your calibrated frequency (ours is at 63 MHz) to achieve a peak reading. Select R21 typically on 80K ohm ±20K ohm for a S/N reading after depressing switch to be ±1 dB from your standard.

XII. Video

1) Connect the video signal to the RF in on the Sam.
2) Connect the video vert on the Sam to the vertical on the scope at .1V per division.
3) Adjust R27 for 85% scope reading on the video Portion of the signal.
4) The signal should be .1V out of DC level and be .7 cm high with the peaks touching .1V and .8V respectively.

XIII. Spurs

1) Turn the +10dB gain potentiometer on the front panel all the way clockwise and set the attenuator to the lowest scale (-20dB).
2) Tune the Sam from 4.0 MHz to the highest frequency of your meter, you should not see any meter deflection.

XIV. Voltmeter

1) Place function switch to the voltmeter position.
2) Connect AC and DC voltage, they should be ±5%.

XV. Frequency Accuracy

1) Connect MC-50 or meter calibrator to RF in on Sam at 150 MHz at +20 dB.
2) Tune in Sam for reading at 150 MHz with AFC off. If the signal doesn't peak, tune T1 on mainboard until the signal peaks.
3) Tune in Sam now with AFC on, the needle should not move. If it moves down, tune the blue slug of the Mx1 discriminator until the needle peaks.
4) If the needle moves up when you try to peak on the signal, turn AFC off and peak on signal at 150 MHz at +20 dBmV, then turn AFC on again. DO NOT TRY TO REPEAK THE SAM. At this time repeak the R.F. tuning caps on the R.F. assembly.

XVI Charging Circuit

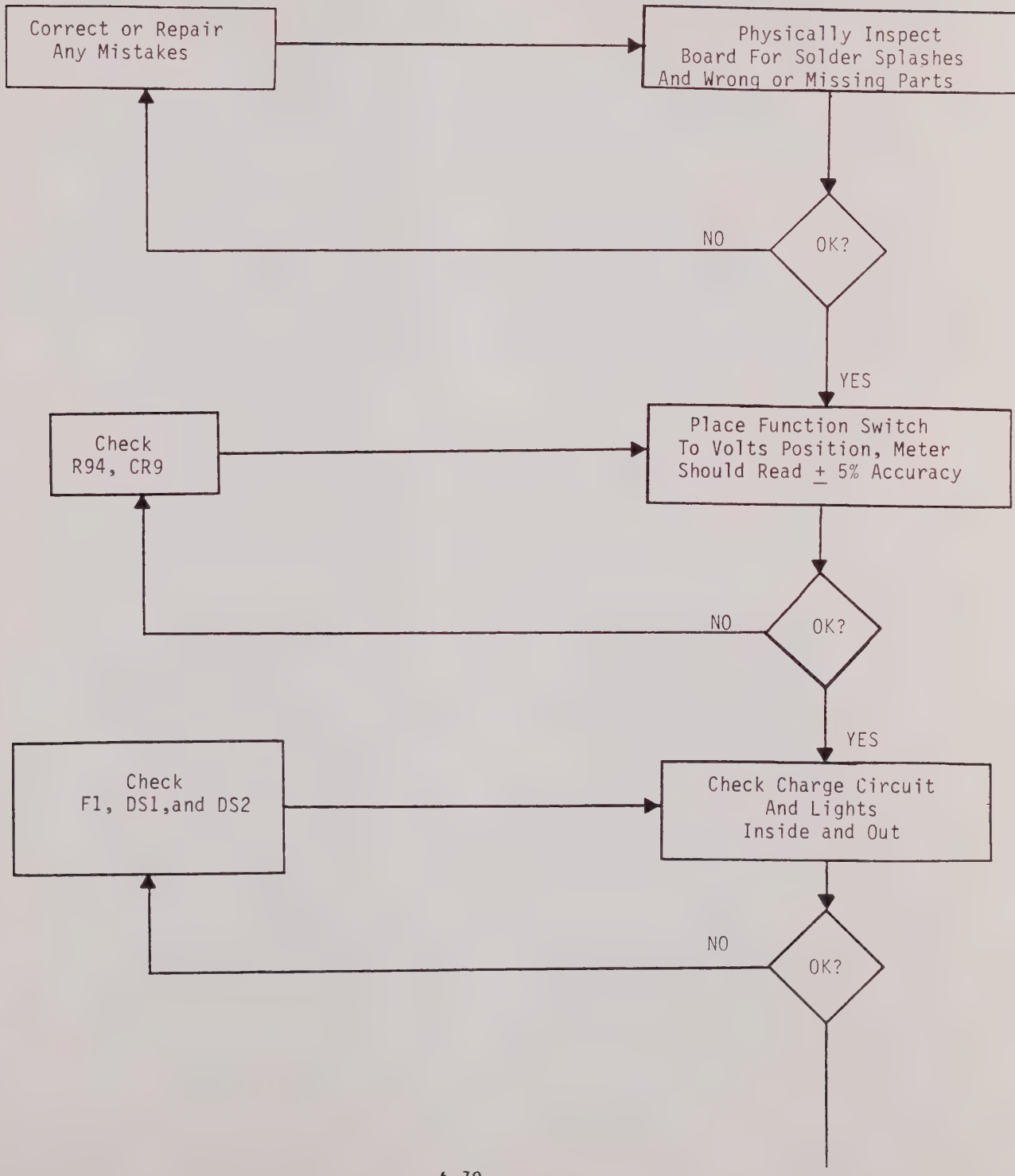
1) With the Sam connected to an external power supply, it will consume approximately 300 mA, this is with the light switch on and the volume turned fully on.
2) Plug in the AC charge plug to the Sam, observe the power supply-the current should drop to approximately 150 MA. At this time both the inside charge light and the front panel charge light should be on.

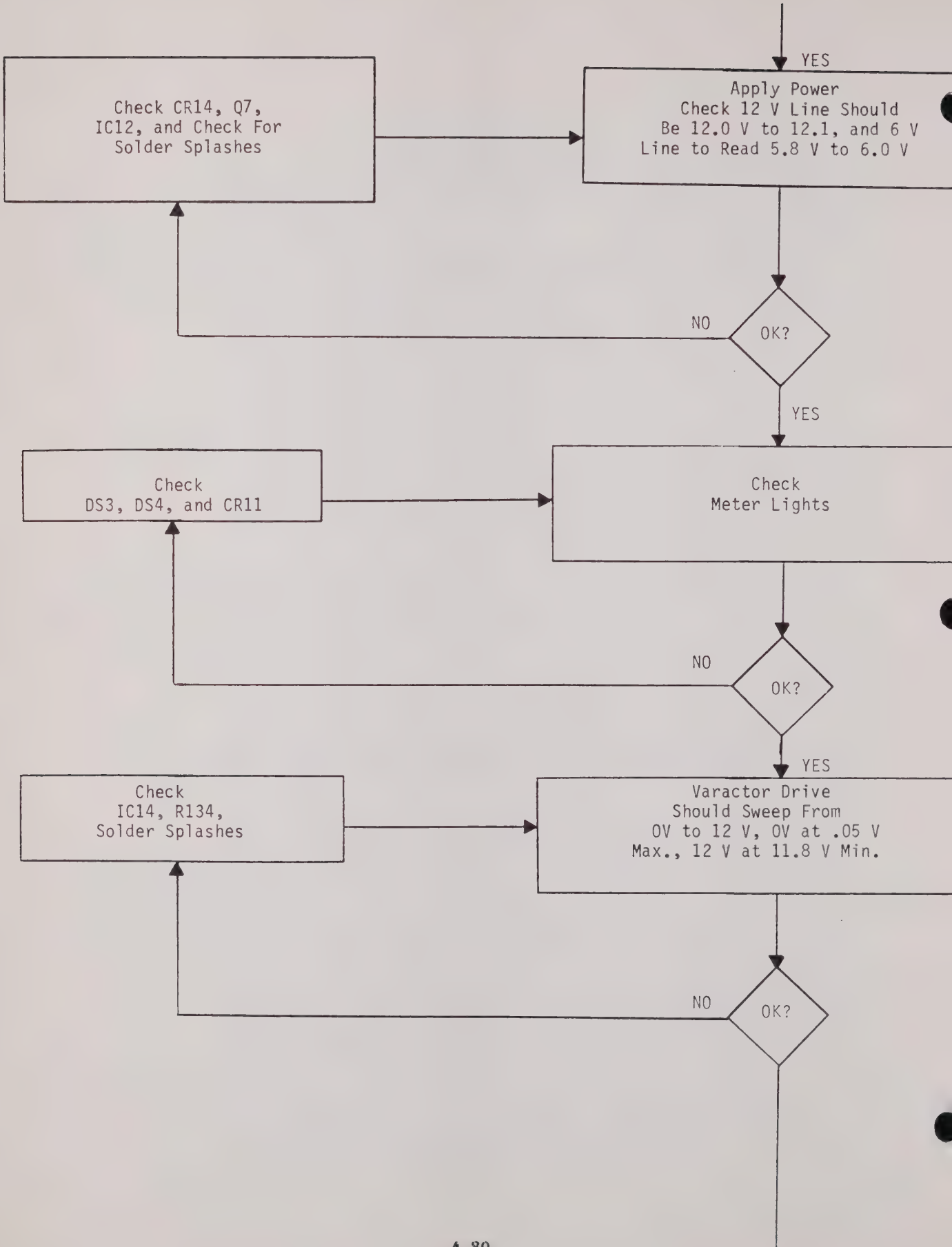
XVII Calibrator

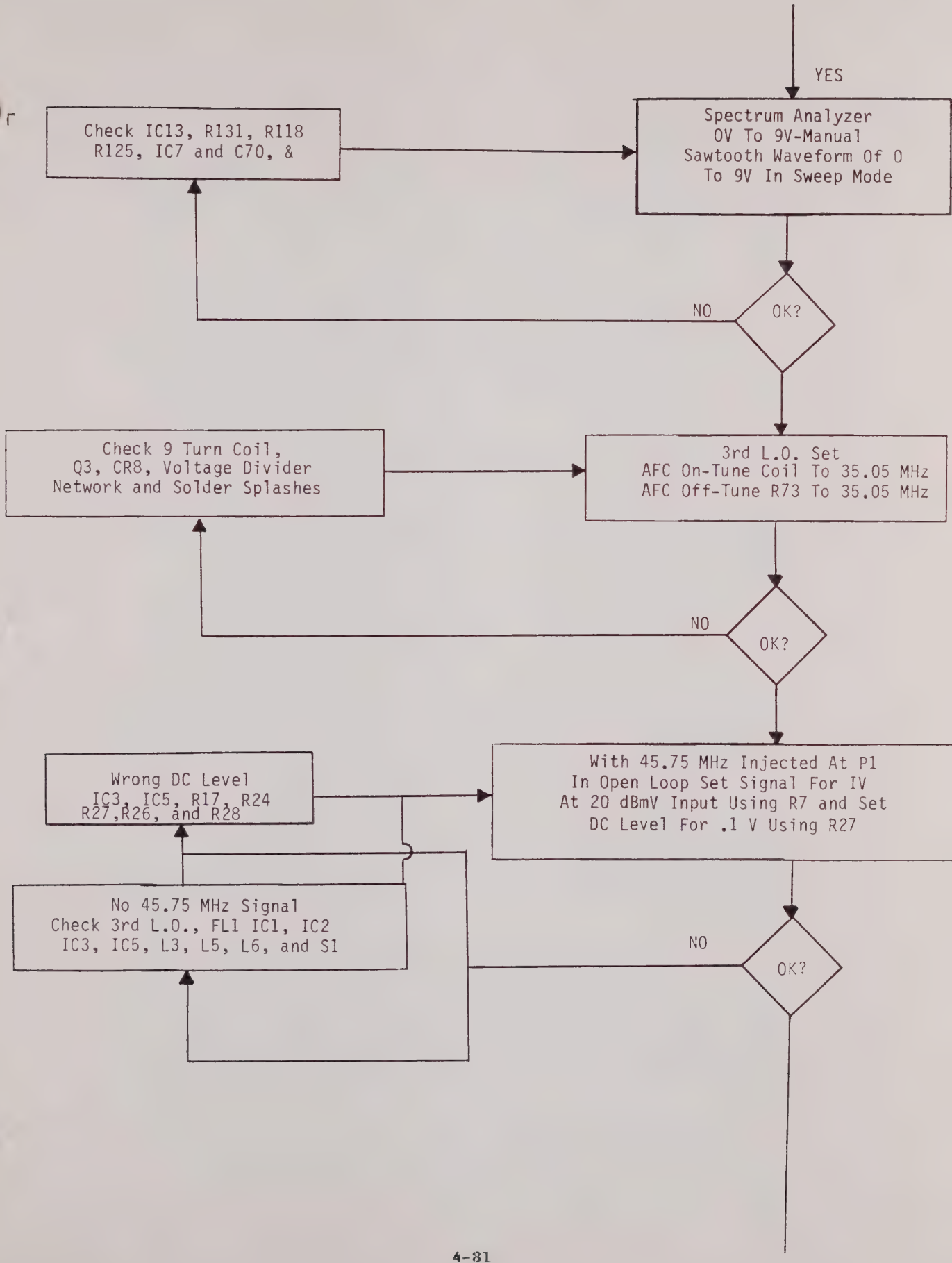
1) Connect a cable from a frequency counter to the calibrator out on the Sam.
2) Adjust L11 on the Sam mainboard for 150 MHz ±.1 MHz.
3) Adjust R102 for +20 dBmV on the meter.

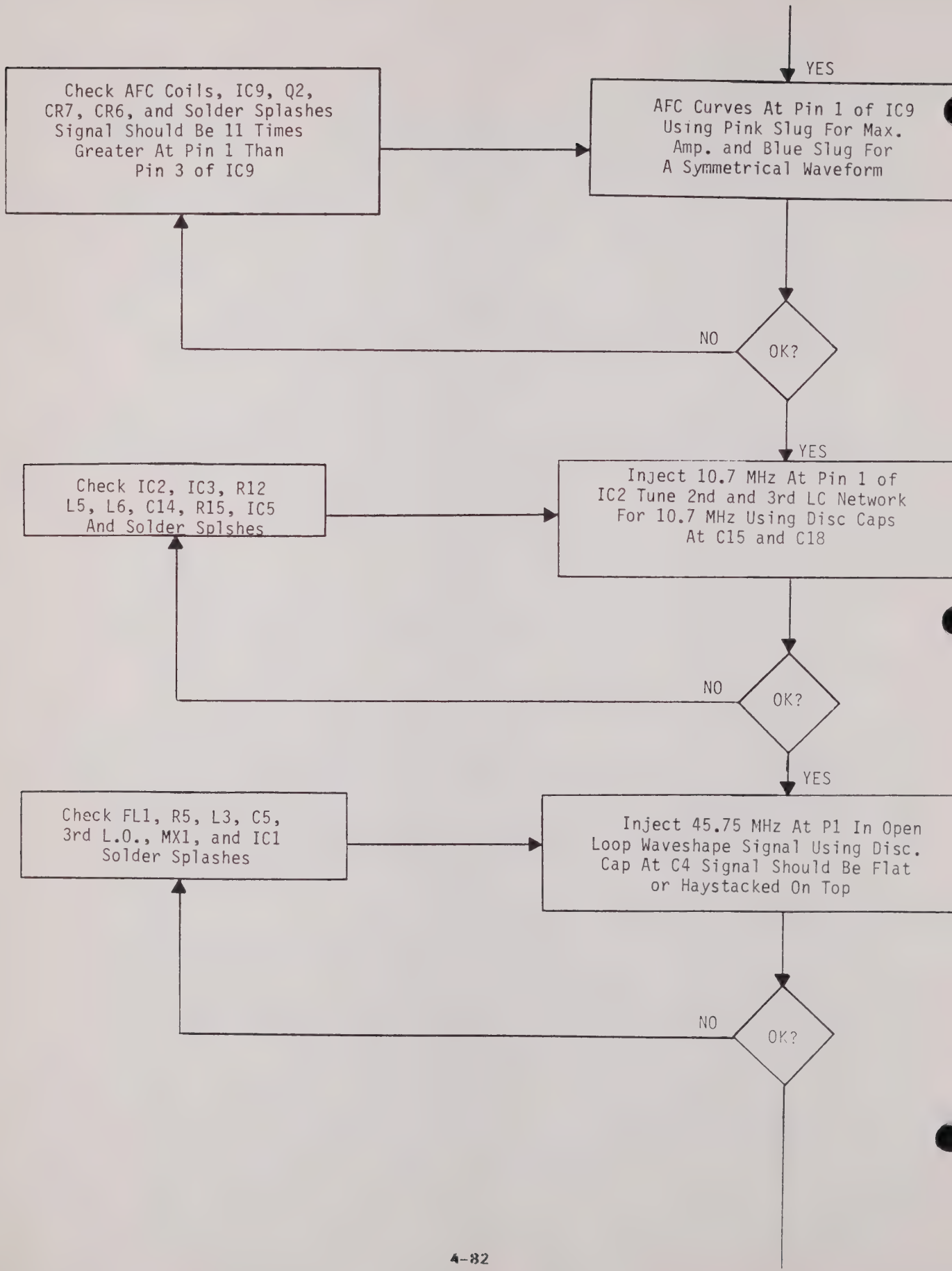
SAM MAIN BOARD

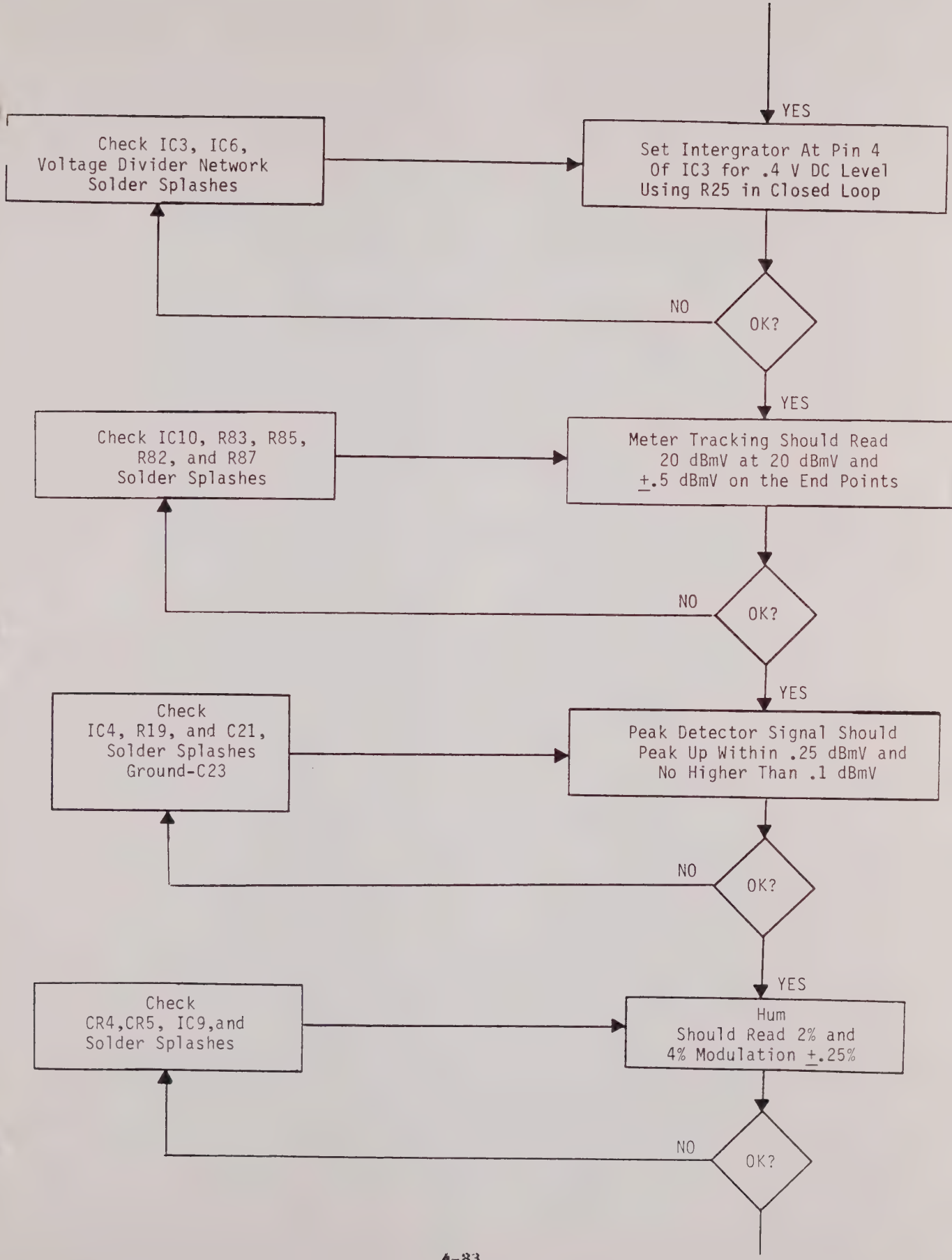
(Troubleshooting)




YES
Apply Power
Check 12 V Line Should
Be 12.0 V to 12.1, and 6 V
Line to Read 5.8 V to 6.0 V
Check CR14, Q7,
IC12, and Check For
Solder Splashes
NO
OK?
YES
Check
Meter Lights
Check
DS3, DS4, and CR11
NO
OK?
YES
Varactor Drive
Should Sweep From
0V to 12 V, 0V at .05 V
Max., 12 V at 11.8 V Min.
Check
IC14, R134,
Solder Splashes
NO
OK?

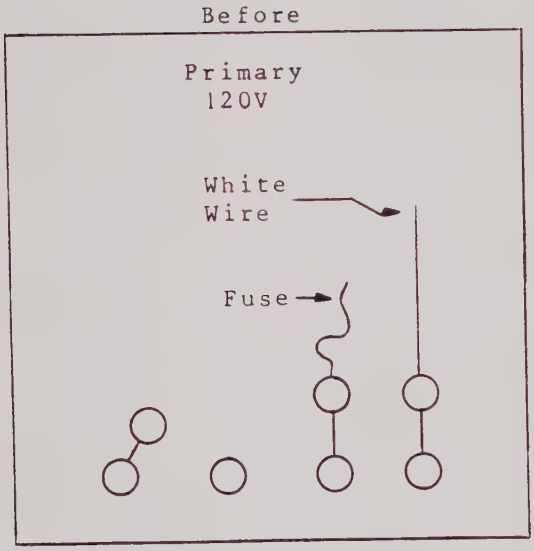

YES
Spectrum Analyzer
0V To 9V-Manual
Sawtooth Waveform Of 0
To 9V In Sweep Mode
OK?
NO
Check IC13, R131, R118
R125, IC7 and C70, &
3rd L.O. Set
AFC On-Tune Coil To 35.05 MHz
AFC Off-Tune R73 To 35.05 MHz
OK?
NO
Check 9 Turn Coil,
Q3, CR8, Voltage Divider
Network and Solder Splashes
With 45.75 MHz Injected At P1
In Open Loop Set Signal For IV
At 20 dBmV Input Using R7 and Set
DC Level For .1 V Using R27
OK?
NO
Wrong DC Level
IC3, IC5, R17, R24
R27,R26, and R28
No 45.75 MHz Signal
Check 3rd L.O., FL1 IC1, IC2
IC3, IC5, L3, L5, L6, and S1

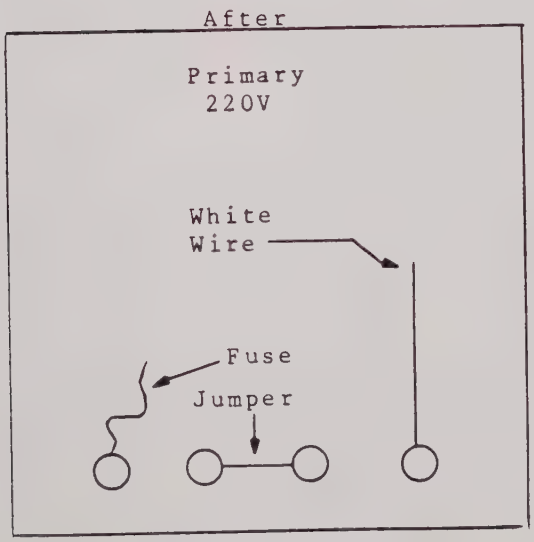

YES
AFC Curves At Pin 1 of IC9 Using Pink Slug For Max. Amp. and Blue Slug For A Symmetrical Waveform
Check AFC Coils, IC9, Q2, CR7, CR6, and Solder Splashes Signal Should Be 11 Times Greater At Pin 1 Than Pin 3 of IC9
NO
OK?
YES
Inject 10.7 MHz At Pin 1 of IC2 Tune 2nd and 3rd LC Network For 10.7 MHz Using Disc Caps At C15 and C18
Check IC2, IC3, R12 L5, L6, C14, R15, IC5 And Solder Splshes
NO
OK?
YES
Inject 45.75 MHz At P1 In Open Loop Waveshape Signal Using Disc. Cap At C4 Signal Should Be Flat or Haystacked On Top
Check FL1, R5, L3, C5, 3rd L.O., MX1, and IC1 Solder Splashes
NO
OK?


YES
Set Intergrator At Pin 4
Of IC3 for .4 V DC Level
Using R25 in Closed Loop
OK?
NO
Check IC3, IC6,
Voltage Divider Network
Solder Splashes
YES
Meter Tracking Should Read
20 dBmV at 20 dBmV and
±.5 dBmV on the End Points
OK?
NO
Check IC10, R83, R85,
R82, and R87
Solder Splashes
YES
Peak Detector Signal Should
Peak Up Within .25 dBmV and
No Higher Than .1 dBmV
OK?
NO
Check
IC4, R19, and C21,
Solder Splashes
Ground-C23
YES
Hum
Should Read 2% and
4% Modulation ±.25%
OK?
NO
Check
CR4,CR5, IC9,and
Solder Splashes

Sam Conversion From 120V to 220V

(Charge Circuit)





-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
0012-10-9011	ASY DWG,LCD BOARD	1.000
0012-20-9004	ASSY DWG, PROC BD	1.000
0014-20-9002	SCH, LCD BOARD	1.000
0014-30-9005	SCH, PROCESSOR BD	1.000
0016-00-9016	TEST PROC,PROC PC BD	1.000
0016-00-9017	TEST PROC,LCD BD	1.000
0412-00-9018	ASY DWG,VHF OSC PCB	1.000
0412-00-9019	ASY DWG,UHF OSC PCB	1.000
0412-00-9020	MOD.INSTRUCTION	1.000
0412-10-9025	ASY DWG,PRESCALER BD	1.000
0412-10-9026	ASY DWG,UHF INTRFACE	1.000
0412-30-0000	PC ASY,SAM MAIN BD	1.000
0412-30-0006	ASY DWG,SAM III WRAP	1.000
0413-00-9016	PROGRAM:8410-00-0041	2.000
0414-10-9013	SCH,PRESCALER PCB	1.000
0414-10-9014	SCH,UHF OSC PCB	1.000
0414-10-9015	SCH, VHF OSC PCB	1.000
0414-30-0014	SCH, SAM III MAIN BD	1.000
0414-30-0028	SCH,RF CONVERTER	1.000
0414-30-9019	SCH,UHF INTERFACE	1.000
0416-00-9032	TEST PROC,SAM IIID-	1.000
0417-00-9001	PERFORMANCE SPEC	1.000
0417-00-9002	PERFORMANCE SPEC,	1.000
0417-00-9020	PERFORMANCE SPEC	1.000
0417-00-9021	PERFORMANCE SPEC,	1.000
0417-00-9022	PERFORMANCE SPEC	1.000
0417-00-9023	PERFORMANCE SPEC	1.000
1110-00-0410	METER BD,SAM I & II	1.000
1110-40-0000	MAIN BD, SAM III	1.000
1110-40-0001	PC ASSY, LCD BD-III	1.000
1110-40-9018	PC ASY,PROCESSOR,UHF	1.000
1111-00-0114	CASE,SAM	1.000
1113-20-0051	ATTEN,7570-06	1.000
1118-10-2013	ROTOR ASSY,7570	1.000
1118-10-2106	F PLATE AY,7570-05	1.000
1118-10-2228	ENCL ASSY,7570-06	1.000
1118-10-2403	CONN KIT	1.000
1118-40-0001	FP ASSY, SAM III	1.000
1118-40-0003	DC BLOCK, SAM	1.000
1118-40-9028	FINAL ASSY,SAM IIID-	1.000
1210-32-0019	COIL,4T	1.000
1210-42-0050	RF XFMR	1.000
1210-43-0007	COIL,19T,24GA	1.000
1210-43-0008	RF XFMR	1.000
1216-00-0018	CHASSIS,RF,SAM III	1.000
1216-40-0000	CHASSIS,SAM	1.000
1216-40-0010	SAM CASE W/O BATT	1.000
1217-70-0069	CABLE ASSY,5 1/2IN	1.000
1217-70-0070	CABLE ASSY,7 1/2IN	1.000
1217-70-0071	CABLE ASSY,6IN	1.000
1218-40-0002	PRELIM LCD PC BD	1.000
1218-40-0003	PRELIM PCB, SAM PROC	1.000
1218-40-0015	MAIN BD PRELIM,SAM I	1.000
1218-40-9017	PC ASSY,PRESCALER	1.000
1218-40-9018	PC ASSY,OSC,VHF	1.000
1218-40-9019	PC ASSY,OSC,UHF	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1219-00-0226	HARNESS,SAM III RF	1.000
1219-00-0229	BATT ASSY,SAM	1.000
1219-00-0230	HARNESS KIT, SAM III	1.000
1219-00-0280	RF SUBAY 0,	1.000
1219-00-0400	MAIN BD FINAL,	1.000
1219-00-9004	HARNESS, MAIN/PROC	1.000
1219-00-9005	HARNESS, KEYBD/LCD	1.000
1219-00-9006	HARNESS, RS232/LCD	1.000
1219-00-9007	HARNESS, TEMP SENSOR	1.000
1219-40-0003	LCD BD FINAL KIT	1.000
1219-40-0004	HARNESS, LCD/PROC	1.000
1219-40-0008	PROC BD FINAL KIT	1.000
1219-40-0009	COIL KIT,SAM MAIN BD	1.000
1219-40-0010	HARNESS,SAMJR UHF RF	1.000
1219-40-0011	CABLE SET, SAM I	1.000
1219-40-0012	CABLE,RS-232,5 COND	1.000
1219-40-0036	SAM IIID SHIPPING KT	1.000
1219-40-0069	OPT KIT,SAM IIID-UHF	1.000
1219-40-0070	RF SUBAY 3-4	1.000
1219-40-0071	RF SUBAY 5-6	1.000
1219-40-9027	RF SUBAY 1-2	1.000
1410-01-1890	SAM LID LATCH BAR	1.000
1410-01-1960	SPEAKER GRILL 2 X 2	1.000
1410-01-1980	HUDSON CAN HU-5566	1.000
1410-01-2000	ROD, 8 7/8"X1/4" DIA	1.000
1410-01-2010	DRUM, TAPPED,	2.000
1410-01-2030	GEAR, TAPPED,	2.000
1410-01-2040	SAM CLEAR PLEXIGLASS	1.000
1410-01-2160	ADAPTER FOR SAM PER B/P	1.000
1410-30-2200	SAM LID PLATE	1.000
1410-30-2210	SAM SPEAKER BRACKET	1.000
1410-30-2220	SAM RF LID COVER PER	2.000
1410-30-2240	SAM RIGHT ANGLE B/P	1.000
1410-30-2570	FISH PAPER PER B/P	1.000
1410-30-2600	HOLDER FOR SAM I &	1.000
1410-80-0750	SAM RF METAL WORK	1.000
1410-80-1000	CAB SEAL, SAM,	1.000
1411-00-0160	FOLLOWER CAM	1.000
1411-00-0270	SHAFT ADAPT.PER B/P	1.000
1411-00-0410	SHAFT	1.000
1411-00-0430	COUPLING PER B/P	1.000
1411-00-0450	PLATE,REAR	1.000
1411-00-0520	COUPLING	1.000
1411-00-0530	COUPLING	1.000
1411-00-0550	CONTACT PLATE	2.000
1411-00-0670	MOLD PLAS. ROTOR B/P	2.000
1411-00-1110	CONTACT	20.000
1411-00-1130	CONDUCTOR	1.000
1411-00-1820	WIPER CONTACT	2.000
1411-00-2080	BALL BEARING	2.000
1411-00-2090	DETENT SPRING	4.000
1411-00-2160	ENCLOSURE	1.000
1411-00-6260	SPACER PER B/P	1.000
1411-11-2820	COVER/STOP PL,	1.000
1411-11-2830	SHAFT,DETENT,PER B/P	1.000
1411-11-3560	FINGER CONTACT STRIP PER B/P	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1411-11-3570	PLATE FRONT	1.000
1411-11-3615	DETENT SHAFT PER B/P	1.000
1414-00-1002	COPPER TAPE 1610-02-0002	2.000
1414-00-1003	BUSHING,	1.000
1414-00-1013	BATTERY SUPPORTS	2.000
1414-00-1015	BRACKET, METER	1.000
1414-00-9062	MTG PLATE, "PER B/P"	1.000
1414-00-9065	BRKT,MTG,UHF OSC PCB	1.000
1414-60-1004	FRONT PANEL,SAM IIID	1.000
1414-80-1000	WRAPAROUND,PER B/P	1.000
1510-00-1102	CAP,CHIP,1000PF,50V	18.000
1510-00-2750	CAP.,CHIP 75PF 10%	2.000
1510-00-3104	CAP.,CHIP,.1 MF	3.000
1510-00-5470	CAP,CHIP,47PF	3.000
1510-00-9102	CAP,CHIP,1000	6.000
1510-10-0100	CAP,DISC,1KV,10PF	3.000
1510-10-0101	CAP,DISC,1KV,100PF	2.000
1510-10-0120	CAP,DISC,1KV,12PF	1.000
1510-10-0121	CAP,DISC,1KV,120PF	1.000
1510-10-0150	CAP,DISC,1KV,15PF	1.000
1510-10-0200	CAP,DISC,1KV,20PF	3.000
1510-10-0202	CAP,DISC,1KV,2PF	2.000
1510-10-0309	CAP,DISC,1KV,3PF	1.000
1510-10-0330	CAP,DISC,1KV,33PF	1.000
1510-10-0500	CAP,DISC,1KV,50PF	5.000
1510-10-0609	CAP,DISC,1KV,6PF	1.000
1510-10-0750	CAP,DISC,1KV,75PF	5.000
1510-10-1302	CAP,DISC,1KV,.003UF	1.000
1510-10-1471	CAP,DISC,1KV,470PF	1.000
1510-10-7471	CAP,DISC,50V,470PF	4.000
1510-11-1154	CAP,DISC,100V,.15UF	12.000
1510-11-3105	CAP,MON,50V,1UF	3.000
1510-12-0102	CAP,DISC,1000PF	1.000
1510-12-1102	CAP,DISC,1000PF	14.000
1510-12-2103	CAP,DISC,80/20,.01MF	4.000
1510-12-2104	CAP,DISC,80/20,.1MF	13.000
1510-12-2224	CAP,DISC,Z12V,.22MF	2.000
1510-12-3331	CAP,DISC,330	3.000
1510-14-4103	CAP,MON,50V,.01UF	1.000
1510-21-7100	CAP,TANT,25V,10UF	4.000
1510-23-4101	CAP,ELEC,25V,100UF	4.000
1510-23-5221	CAP,ELEC,16V,220UF	1.000
1510-23-7150	CAP,ELEC,25V,15UF	1.000
1510-23-9222	CAP,ELEC,16V,2200UF	1.000
1510-24-0229	CAP,TANT,25V,2.2UF	6.000
1510-25-1102	CAP,ELEC,50V,1000UF	1.000
1510-26-2331	CAP,TANT,6.3V,330UF	3.000
1510-31-8501	CAP,FT,500PF	13.000
1510-31-8759	CAP,FT,500V,7.5PF	1.000
1510-40-0139	CAP,COMP,500V,1.3PF	1.000
1510-40-1019	CAP,COMP,500V,.1PF	1.000
1510-40-1119	CAP,COMP,500V,1.1PF	2.000
1510-40-1228	CAP,COMP,500V,.22PF	1.000
1510-40-1279	CAP,COMP,500V,2.7PF	1.000
1510-50-6102	CAP,MICA,100V,1000PF	1.000
1510-61-8474	CAP,MYLR,100V,.47UF	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1510-61-9338	CAP,MYLR,200V,.33PF	1.000
1510-70-1030	CAP,VAR,.5-3PF	1.000
1510-71-2859	CAP,VAR,.8-8.5PF	2.000
1510-71-3100	CAP,VAR,10PF	3.000
1610-02-0002	TAPE,COPPER,1/4", (18YDS.PER RL)	3.680
1710-00-2350	PC BOARD, 080-044F FROM:3210-05-0052	1.000
1710-00-2900	DS PC BOARD,ZZ1015	1.000
1710-00-2910	DS PC BOARD,ZZ1016	1.000
1710-00-3800	PC BOARD, 080-045C FROM:3210-05-0044	1.000
1714-00-0000	SAM IST L.O. PCB FROM:3210-05-0046	2.000
1714-00-0004	PCB,SAM III SHIELD	1.000
1714-00-9017	PCB,PRESCALER	1.000
1810-01-5100	CHOKE,MOLDED,510UH	2.000
1810-06-0002	COIL,110 T	1.000
1810-06-0003	COIL,TAPPED,1:1-1/2	2.000
1810-06-0004	COIL,TAPPED,1:4	1.000
1810-10-0189	CHOKE,MOLDED,1.8 UH	9.000
1810-10-0220	CHOKE,MOLDED,22 UH	7.000
1810-10-0560	CHOKE,MOLDED,56 UH	2.000
1811-04-0001	DISCRIMINATOR COIL	1.000
1813-00-0007	FERR. BEAD,LC000-009	12.000
1813-00-0033	COIL FORM	2.000
1813-00-0036	SLUG CORE	2.000
1813-00-0038	COIL MNTG. BASE	2.000
1813-00-0039	COILFORM	2.000
1813-00-0052	FERRITE SLEEVE	1.000
1813-00-0053	BALUN CORE	2.000
1815-00-0017	COIL,4-1/2T,#22	1.000
1815-00-0099	COIL,AIR,	1.000
2110-00-0001	ADPTR,F-F/F-F,1.13	1.000
2110-01-1001	CONN,BNC-F,75,FLANGE	2.000
2110-01-1002	CONN,BNC-F,75,FLANGE	2.000
2110-06-0001	CONN.,F	2.000
2110-06-0004	ADPTR,F-F/F-F,.80	1.000
2110-06-1005	CONN,F,W/HDWR	4.000
2111-00-0007	NUT, BANANA JACK	1.000
2112-00-0007	IC SKT,8 PIN	1.000
2112-00-0011	IC SKT,PC,14 PIN	10.000
2112-00-0012	IC SKT,16 PIN	17.000
2112-00-0013	IC SKT,PC,24 PIN	6.000
2112-00-0021	IC SOCKET,40-PIN	1.000
2112-00-0022	IC SOCKET,18-PIN	1.000
2112-00-0023	IC, SKT,28-PIN	1.000
2112-00-0029	SOCKET,STRIP,20 PIN	2.000
2112-01-0005	JACK,BANANA,RD	1.000
2112-01-0006	JACK,BANANA,BK	1.000
2112-03-0009	GROUND, LUG #6	1.000
2112-03-0024	TERM,LCKNG,3/8IN	4.000
2112-03-0026	SOLDER LUG	1.000
2112-04-0004	CONNECTOR	2.000
2112-04-0005	CONNECTOR	1.000
2112-05-0006	CONN.,MALE 5-PIN	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
2112-05-0010	CONN., MALE, 2-PIN	2.000
2112-07-0000	HEADER, 36-PIN, STRT.	2.076
2112-07-0001	HEADER, 3-PIN STRT	5.000
2112-07-0003	HEADER, 10-PIN STRT	3.000
2112-07-0006	HEADER, 8-PIN STRT	1.000
2112-07-0007	HEADER, STRT, 2 PIM	1.000
2112-07-0008	HEADER, 6-PIN, STR.	2.000
2112-07-0020	HEADER, 1-PIN, STRT	2.000
2112-07-0025	CONN., MALE, 10-PIN	1.000
2112-10-0002	PV JUMPER	9.000
2112-12-0005	PHONO JACK	1.000
2112-12-0006	PLUG, PHONO, LONG	1.000
2112-16-0011	CARD GUIDE, 4 IN	2.000
2112-32-0001	AC RECEPTACLE, EUR, 6A	1.000
2112-32-0003	PLUG, BATTERY, 10-12IN	2.000
2112-35-0002	CONN, PC, 20-PIN	1.000
2112-36-0001	SOCKET, RIBBON CABLE,	1.000
2113-06-0008	JACK, FEMALE, 5-CKT	1.000
2113-06-0014	CONN, FEMALE, 2-PIN	2.000
2113-06-0016	CONN., FEMALE, 10-PIN	1.000
2113-07-0001	CONTACT MC000-068	5.000
2113-07-0002	CONTACT, MC000-131	9.000
2113-10-0001	HSG, MINI-LATCH, 5-PIN	1.000
2113-10-0002	HSG, MINI-LATCH, 6-PIN	2.000
2113-10-0006	HSG, MINI-LATCH, 4-PIN	1.000
2113-10-0008	HSG, MINI-LATCH, 3-PIN	1.000
2113-10-0009	HSG, MINI-LATCH, 8-PIN	1.000
2113-10-0010	HSG, MINI-LATCH, 10PIN	1.000
2113-20-0001	TERM, MINI-PV	3.000
2113-20-0002	TERM, MINI-PV, STRIP	31.000
2113-23-0001	PLUG, POLARIZING	5.000
2113-33-0006	CAP, FEM, D	1.000
2113-36-0002	HOOD	2.000
2310-00-0531	CRYSTAL, 82.850000MHZ	1.000
2310-00-1081	CRYSTAL, 2.0000 MHZ	1.000
2410-01-0034	KNOB, BLK, 1/8-IN	1.000
2410-01-0035	KNOB, BLK, 1/4-IN	2.000
2410-01-0038	KNOB	1.000
2410-01-0039	KNOB W/8-32 SET	1.000
2410-01-0040	KNOB, DUAL, BLK. W/SET SCREWS	1.000
2410-02-0006	LAMP	1.000
2410-02-0007	LAMP, WH, 14V	1.000
2410-02-0008	LAMP	4.000
2410-03-0006	DSPLY, LCD, 4-DGT, .5IN	1.000
2410-04-0001	DECAL, SER.NO.	2.000
2410-04-0463	DECAL, ATTEN DRUM	2.000
2410-04-0564	DECAL, SAM CAL	1.000
2410-05-0018	FUSE, 1A, 250V, QUICK	1.000
2410-06-0022	METER, SAM	1.000
2411-04-0058	7570-06 DECAL, ATTEN.	1.000
2414-04-0006	DECAL, BATT CHG, SAM	1.000
2414-14-0002	DECAL, SAM GUARANTEE	1.000
2710-02-0002	FILTER, SFE, 10.7MA	1.000
2810-00-0007	CABLE CLAMP, 3/16	1.000
2810-00-0015	CBL CLMP, LKG, ADH, 1/4	1.000
2810-02-4108	SPACER, THD, 4-40X1/2	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
2810-03-4107	SPACER,RND,THRD.,	2.000
2810-04-2005	SPACER,2X5/16,3/160D	1.000
2810-10-0034	RUBBER GROMMET	2.000
2810-10-0035	GROMMET,RBBR,3/16	1.000
2810-11-0020	SHOULDER WASHER, BK	2.000
2810-11-0021	HEATSINK, TO-18	1.000
2810-12-0035	LATCH,ARROWHEAD	1.000
2810-12-0036	ROLLER,NYLON STD.	2.000
2810-12-0037	GEAR,NYLON	2.000
2810-12-0038	3/4IN CLIP AND	4.000
2810-12-0070	LOUVER,SCRN,1 IN DIA	1.000
2810-14-4100	NUT,4-40,HN101-400	2.000
2810-14-4104	NUT,4-40X1/4,NP	2.000
2810-15-0001	NUT,HEX,3/8-32X1/2AF	6.000
2810-15-0006	NO.8 FLEX LOC NUT,ZP	4.000
2810-16-0018	NUT,HEX 6-32X5/16,ZP	2.000
2810-16-0019	NUT,HEX,4-40X1/4X	2.000
2810-16-0020	NUT,DRESS,FLARED	8.000
2810-17-2103	SCW,SBH,2-56X3/16	3.000
2810-17-2104	SCW,SBH,2-56X1/4	1.000
2810-17-4104	SCW,SBH,4-40X1/4	2.000
2810-17-4106	SCW,SBH,4-40X3/8	4.000
2810-17-8104	SCW,SBH,8-32X1/4	1.000
2810-17-8106	SCW,SBH,8-32X3/8	5.000
2810-23-0031	SCREW,PAN HD,BLK,	6.000
2810-23-0034	SCREW,SWG,PAN,PHIL	22.000
2810-23-0035	SCREW,PAN HD.,	10.000
2810-23-0037	SCW,SLT HEX WSHR HD	6.000
2810-23-0043	SCREW,PAN HD,	10.000
2810-23-0062	SCREW,2-56X5/16,BK	1.000
2810-23-0082	SCW,SFIL,2-56X3/4	2.000
2810-24-4000	LO,WASHER,INT,4	5.000
2810-24-6000	INT,LOWASHER,6	3.000
2810-25-4000	LWASHER,EXT,4	2.000
2810-26-0012	WSHR,SPCR,6,.140ID	2.000
2810-28-0003	LW,INT,SPEC,3/8 ID	5.000
2810-28-0010	WASHER,5804-43-1	1.000
2810-28-0027	WASHER, TENSION	2.000
2810-28-0041	WASHER,FLAT	7.000
2810-30-0011	RIVET	6.000
2810-42-4102	ST SCRW,SKT,4-40X1/8	1.000
2810-42-4103	SS,KN,CUP,4-40X3/16	1.000
2810-42-4106	SET SCREW,SKT,CUP PT	2.000
2810-43-6103	ST SCREW,CONE,SKT	6.000
2810-45-0003	FLANGED BEARING	2.000
2810-56-2103	SCW,PFIL,2-56X3/16	2.000
3010-11-0002	SPKR,2-1/4 45 OHM	1.000
3010-12-0009	CASE	1.000
3010-54-0004	MIXER,DBL.BAL.	1.000
3010-54-0005	MIXER,DBL.BAL.	1.000
3210-05-0044	G-10FR,1/16X12X16	0.083
3210-05-0046	G-10FR,1/16X12X16	0.535
3210-05-0047	G-10FR,1/32X10X12	0.500
3210-05-0052	G-10FR,1/16X12X18,	0.500
4010-00-0013	BATTERY PACK,SAM	1.000
4510-00-0002	RELAY,SPDT MR000-002	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4510-00-0022	RELAY, DPDT, 12 V	1.000
4610-00-2104	POT, 100K, RP130-410	1.000
4610-00-2202	POT, 2K, RP130-220	2.000
4610-01-4101	POT, 100	3.000
4610-01-4102	POT, 1K	1.000
4610-01-4103	POT, 10K	3.000
4610-01-4202	POT, 2K	2.000
4610-01-4203	POT, 20K	2.000
4610-01-4204	POT, 200K	2.000
4610-01-4205	POT, 2M	2.000
4610-13-4202	POT, CERMET, 2K	1.000
4610-13-4203	POT, CERMET, 20K	1.000
4610-14-7103	POT, 10K, 10T	1.000
4610-14-8253	POT, 25K	1.000
4610-31-1102	POT/SWITCH, 1K	1.000
4610-31-2103	POT/SWITCH, 10K	1.000
4610-31-4103	POT/SWITCH, 10K	1.000
4610-40-4106	POT, DUAL, 1M, 10K	1.000
4700-05-2201	RES, C, 1/8W, 5%, 2.2K	1.000
4700-05-4704	RES, C, 1/8W, 5%, 4.7M	2.000
4700-15-1000	RES, C, 1/4W, 5%, 100	1.000
4700-15-1001	RES, C, 1/4W, 5%, 1K	6.000
4700-15-1002	RES, C, 1/4W, 5%, 10K	32.000
4700-15-1003	RES, C, 1/4W, 5%, 100K	12.000
4700-15-1004	RES, C, 1/4W, 5%, 1M	1.000
4700-15-1005	RES, C, 1/4W, 5%, 10M	1.000
4700-15-1009	RES, C, 1/4W, 5%, 10	4.000
4700-15-1201	RES, C, 1/4W, 5%, 1.2K	1.000
4700-15-1302	RES, C, 1/4W, 5%, 13K	1.000
4700-15-1500	RES, C, 1/4W, 5%, 150	4.000
4700-15-1501	RES, C, 1/4W, 5%, 1.5K	3.000
4700-15-1502	RES, C, 1/4W, 5%, 15K	3.000
4700-15-1503	RES, C, 1/4W, 5%, 150K	1.000
4700-15-1801	RES, C, 1/4W, 5%, 1.8K	3.000
4700-15-2000	RES, C, 1/4W, 5%, 200	1.000
4700-15-2001	RES, C, 1/4W, 5%, 2K	1.000
4700-15-2002	RES, C, 1/4W, 5%, 20K	3.000
4700-15-2200	RES, C, 1/4W, 5%, 220	1.000
4700-15-2201	RES, C, 1/4W, 5%, 2.2K	4.000
4700-15-2202	RES, C, 1/4W, 5%, 22K	7.000
4700-15-2203	RES, C, 1/4W, 5%, 220K	1.000
4700-15-2209	RES, C, 1/4W, 5%, 22	1.000
4700-15-2401	RES, C, 1/4W, 5%, 2.4K	1.000
4700-15-2402	RES, C, 1/4W, 5%, 24K	2.000
4700-15-2700	RES, C, 1/4W, 5%, 270	1.000
4700-15-2701	RES, C, 1/4W, 5%, 2.7K	6.000
4700-15-2702	RES, C, 1/4W, 5%, 27K	2.000
4700-15-2708	RES, C, 1/4W, 5%, 2.7	1.000
4700-15-3001	RES, C, 1/4W, 5%, 3K	2.000
4700-15-3300	RES, C, 1/4W, 5%, 330	1.000
4700-15-3301	RES, C, 1/4W, 5%, 3.3K	4.000
4700-15-3901	RES, C, 1/4W, 5%, 3.9K	2.000
4700-15-3902	RES, C, 1/4W, 5%, 39K	1.000
4700-15-4301	RES, C, 1/4W, 5%, 4.3K	1.000
4700-15-4302	RES, C, 1/4 W, 5%, 43K	1.000
4700-15-4700	RES, C, 1/4W, 5%, 470	9.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4700-15-4701	RES, C, 1/4W, 5%, 4.7K	5.000
4700-15-4702	RES, C, 1/4W, 5%, 47K	1.000
4700-15-4703	RES, C, 1/4W, 5%, 470K	1.000
4700-15-4709	RES, C, 1/4W, 5%, 47	1.000
4700-15-5102	RES, C, 1/4W, 5%, 51K	1.000
4700-15-6201	RES, C, 1/4W, 5%, 6.2K	1.000
4700-15-6202	RES, C, 1/4W, 5%, 62K	2.000
4700-15-6800	RES, C, 1/4W, 5%, 680	1.000
4700-15-6801	RES, C, 1/4W, 5%, 6.8K	1.000
4700-15-6803	RES, C, 1/4W, 5%, 680K	1.000
4700-15-6804	RES, C, 1/4W, 5%, 6.8M	1.000
4700-15-7509	RES, C, 1/4W, 5%, 75	2.000
4700-15-8201	RES, C, 1/4W, 5%, 8.2K	6.000
4700-15-8202	RES, C, 1/4W, 5%, 82K	1.000
4700-15-9101	RES, C, 1/4W, 5%, 9.1K	4.000
4700-15-9102	RES, C, 1/4W, 5%, 91K	1.000
4700-15-9109	RES, C, 1/4W, 5%, 91	2.000
4701-03-1001	RES, MF, 1/8W, 1%, 1K	2.000
4701-03-1002	RES, MF, 1/8W, 1%, 10K	5.000
4701-03-1241	RES, MF, 1/8WM1%, 1.24K	2.000
4701-03-1821	RES, MF, 1/8W, 1%, 1.82K	1.000
4701-03-2003	RES, MF, 1/8W, 1%, 200K	3.000
4701-03-6042	RES, MF, 1/8W, 1%, 60.4K	2.000
4701-03-6343	RES, MF, 1/8W, 1%, 634K	1.000
4701-03-8251	RES, MF, 1/8W, 1%, 8.25K	1.000
4701-13-1003	RES, MF, 1/4W, 1%, 100K	1.000
4705-05-1000	RES, C, 1/8W, 5%, 100	2.000
4705-05-1002	RES, C, 1/8W, 5%, 10K	3.000
4705-05-1209	RES, C, 1/8W, 5%, 12	2.000
4705-05-1509	RES, C, 1/8W, 5%, 15	2.000
4705-05-2200	RES, C, 1/8W, 5%, 220	2.000
4705-05-2202	RES, C, 1/8W, 5%, 22K	5.000
4705-05-2409	RES, C, 1/8W, 5%, 24-OHM	2.000
4705-05-2700	RES, C, 1/8W, 5%, 270	2.000
4705-05-3000	RES, C, 1/8W, 5%, 300	3.000
4705-05-3900	RES, C, 1/8W, 5%, 390	4.000
4705-05-4301	RES, C, 1/8W, 5%, 4.3K	2.000
4705-05-9101	RES, C, 1/8W, 5%, 9.1K	2.000
4705-15-3301	RES, C, 1/4W, 5%, 3.3K	1.000
4741-10-7008	RES, L-A, 1/4W, 1%, 107	6.000
4741-11-8009	RES, L-A, 1/4W1%, 1.18K	2.000
4741-14-3008	RES, L-A, 1/4W, 1%, 143	4.000
4741-20-5008	RES, L-A, 1/4W, 1%, 205	2.000
4741-21-0009	RES, L-A, 1/4W1%, 2.10K	2.000
4741-26-7008	RES, L-A, 1/4W, 1%, 267	4.000
4741-37-4008	RES, L-A, 1/4W, 1%, 374	2.000
4741-45-3007	RES, L-A, 1/4W, 1%, 45.3	2.000
4741-66-5008	RES, L-A, 1/4W, 1%, 665	2.000
4741-76-8007	RES, L-A, 1/4W, 1%, 76.8	4.000
4741-80-6007	RES, L-A, 1/4W, 1%, 80.6	4.000
4741-84-5007	RES, L-A, 1/4W, 1%, 84.5	4.000
4741-90-9007	RES, L-A, 1/4W, 1%, 90.9	4.000
4801-01-0825	DIODE, ZENER, 6.2V	1.000
4801-01-4372	DIODE, ZENER, 3.0V	1.000
4801-01-5231	DIODE, ZENER, 5.1V	2.000
4803-02-0006	DIODE, VARACTOR	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4803-02-0011	DIODE,VARACTOR	2.000
4803-02-0020	DIODE, VARACTOR	2.000
4806-01-4007	DIODE,RECT,1000V	1.000
4806-01-5802	DIODE,RECT,50V	1.000
4806-02-0005	DIODE BRIDGE	1.000
4807-01-0034	DIODE,GE PT CONTACT	4.000
4807-01-0082	DIODE,SI PT CONTACT	1.000
4807-01-0914	DIODE,SIGNAL	11.000
4810-02-0007	LED,RD,W/BEZEL	1.000
4812-02-0004	DIODE,SWITCHING	3.000
4901-03-9040	TRANS QA039-040	3.000
4901-03-9060	TRANS QA039-060	1.000
4901-04-3030	TRANSISTOR	1.000
4901-04-4160	JFET,N-CHANNEL	2.000
4901-05-1791	TRANSISTOR,NPN,	7.000
4902-00-0320	TRANSISTOR,POWER	1.000
4902-00-0901	TRANSISTOR, MOT ONLY	2.000
4902-00-0911	TRANSISTOR, MOT ONLY	2.000
4999-00-0007	TRANSISTOR	2.000
5104-00-0034	SWITCH,ROTARY	1.000
5104-02-0001	SWITCH WAFER, 8-POS	1.000
5105-00-0017	SWITCH,SLIDE	1.000
5106-00-0021	SWITCH,TOGGLE,W/HDWR	2.000
5106-00-0022	SWITCH,DPDT,W/HRDWR.	1.000
5106-00-0023	SWITCH,TOGGLE,SPDT	2.000
5106-00-0024	SWITCH,TOGGLE,SPDT	1.000
5106-00-0025	SWITCH,3PDT	1.000
5108-00-0003	KEYBOARD, 16 KEY	1.000
5610-00-0043	TRANSFORMER	1.000
6010-72-4000	WIRE,MAGNET,24GA.	26.000
6010-72-8000	WIRE,MAGNET,28GA.	0.600
6010-73-2000	WIRE,MGNT,32GA,GN	8.000
6010-73-4000	MAGNET WIRE,34 GA.,	0.660
6010-91-4000	WIRE,BUS,14 GA	8.000
6010-91-8000	WIRE,BUSS,18 GA.	14.000
6011-12-0000	SLEEVING,TEF,TW,20GA	2.000
6011-12-2000	SLEEVING,TEF.TW,22GA	7.000
6011-20-2000	SLEEVING,SHRINKABLE,	1.500
6011-20-4000	SLEEVING,SHRINKABLE,	5.000
6011-40-0001	CABLE,SUBMINAX,75	9.500
6011-40-0008	CABLE, RG174/U,	14.750
6011-40-0012	CABLE,59/U,DBL SHLD	14.000
6011-60-0003	RAINBOW CABLE,20COND 7/36 STRAND	24.000
6011-70-0005	CABLE,5-COND,22GA	5.000
6011-80-0006	LINE CORD,3-COND,SVT	1.000
6012-00-0001	TEST LEADS	1.000
6012-12-2000	WIRE,22,BK	18.000
6012-12-2111	WIRE,22,BN	5.000
6012-12-2222	WIRE,22,RD	14.000
6012-12-2333	WIRE,22,OR	7.000
6012-12-2444	WIRE,22,YL	2.000
6012-12-2555	WIRE,22,GN	12.750
6012-12-2777	WIRE,22,VI	10.000
6012-12-2888	WIRE,22,GY	8.000
6012-12-2889	WIRE,22,GY/WH	8.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
6012-12-2991	WIRE, 22, WH/BN	6.000
6012-12-2992	WIRE, 22, WH/RD	6.000
6012-12-2993	WIRE, 22, WH/OR	14.500
6012-12-2994	WIRE, 22, WH/YL	3.000
6012-12-2996	WIRE, 22, WH/BL	8.000
6012-12-2997	WIRE, 22, WH/VI	5.000
6012-12-2998	WIRE, 22, WH/GY	3.000
6012-12-2999	WIRE, 22, WH	82.750
6012-12-4777	WIRE, 24GA, VI	6.000
6012-12-4888	WIRE, 24GA, GY	12.000
6012-12-4999	WIRE PVC, 24GA, WH	24.000
7000-03-1100	VOLTAGE COMPARATOR	1.000
7000-03-2400	QUAD OP AMP	5.000
7000-03-8000	AUDIO POWER AMP	1.000
7000-05-9000	IC	1.000
7000-08-0910	A/D CVTR/8-CH MUX	1.000
7000-13-3000	DETECTOR/BUFFER	1.000
7000-13-5000	IF AMP	2.000
7000-14-5800	DUAL OP AMP	1.000
7000-14-5801	DUAL OP AMP, MOT	1.000
7000-31-6000	WIDE-BAND OP AMP	5.000
7000-76-6000	VOLTAGE CONVERTER	1.000
8000-04-9400	PULSE WD MOD CTL CKT	1.000
8000-05-5810	DAC, 8-BIT	2.000
8000-06-3610	FREQ DIVIDER	1.000
8000-18-0210	MICROPROCESSOR	1.000
8000-18-2310	RAM, 128 WORD X 8-BIT	1.000
8000-18-5210	I/O PORT, 8-BIT	3.000
8000-18-5310	N-BIT, 1 OF 8 DECODER	1.000
8000-27-3210	EPROM, 4096X8	1.000
8000-40-1312	DCD/DEC DCDR	2.000
8000-40-2002	COUNTER, 14 STAGE BIN	1.000
8000-40-4012	BINARY CTR/DVDR	1.000
8000-40-5610	LCD DRIVER	4.000
8000-40-6810	NAND/AND, 8-INPUT	1.000
8000-45-0810	DUAL 4-BIT LATCH	1.000
8001-40-4210	QUAD LATCH	2.000
8001-40-6912	HEX INVERTER	2.000
8001-40-7610	QUAD D, REGISTER	1.000
8001-40-8110	QUAD AND GATE	2.000
8004-01-0712	DUAL 2-INP NAND DRVR	1.000
8007-41-6110	SYNC 4-BIT COUNTER	4.000
8007-49-2210	16-KEY ENCODER	1.000
8410-00-0041	PROM, SAM IIID-UHF REV B	1.000

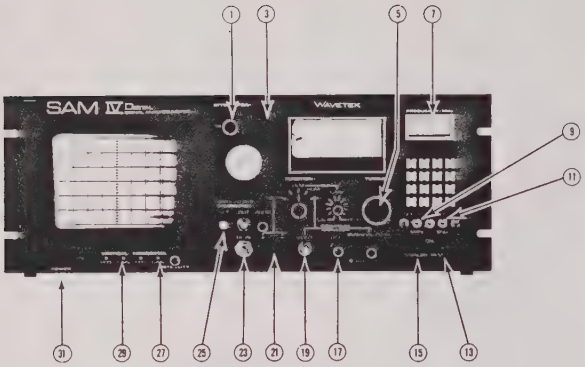
543 records listed.

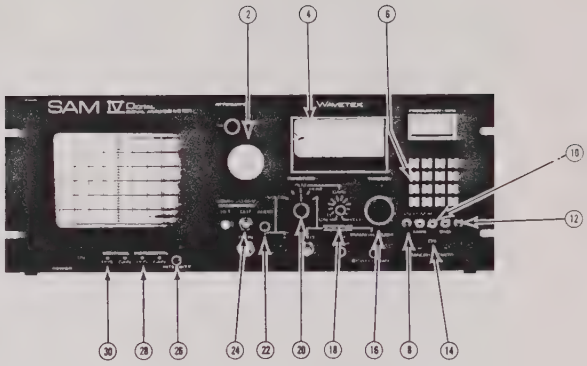
SAM IV INTRODUCTION

The Sam IV Signal Level Meter is a computer controlled, rack mounted measurement system, with a built in display for spectrum analysis. The Sam IV features direct entry keyboard tuning to any of 60 factory set standard channels, and 60 HRC format channels, either video or audio, across the standard 4 to 450 MHz band. The spectrum analysis function of the Sam IV is directly connected to the companion 7-inch CRT display built into the unit. A display range of greater than 50 dB on screen, an amplitude range of -40 to +60 dBmV, a calibrated log display and built in calibration all combine to make the Sam IV an extremely versatile Spectrum Analyzer. The power connection, fusing and the RS232 interface connector are mounted on the rear of the unit for ease of installation.

All Sam IV's are 450 MHz units. They are also available in UHF range. This is not a VHF to UHF converter or adapter: the Sam IV becames a UHF receiver when this mode is selected. The same input connector and attenuator are used for both bands

SAM IV FRONT PANEL





ITEM	DESCRIPTION	PART NUMBER
1	Attenuator Knob	2410-01-0039
2	Speaker Grill	1410-01-1960
3	UHF/VHF Optional Switch	5106-00-0022
4	Meter Bezel	2410-08-0010
5	Course Tune Knob	2410-01-0042
6	Keyboard	5108-00-0003
7	LCD Display	2410-03-0006
8	Signal to Noise Switch	5106-00-0020
9	PGM/Manual Switch	5106-00-0025
10	AFC Switch	5106-00-0021
11	PIX/SND Switch	5106-00-0022
12	Light Switch	5106-00-0021
13	Remote Lamp	4810-02-0016
14	On Lamp	4810-02-0015
15	Standby Lamp	4810-02-0007
16	a) Sweep Rate/Manual Switch	4610-40-4106
	b) Sweep Rate/Manual Knob	2410-01-0040
17	DISP On/Off Knob	2410-01-0035
18	Gain Knob	2410-01-0035
19	Video/Vertical Connector	2110-06-1005
20	Function Knob	2410-01-0039
21	Banana Jack a) Positive	2112-01-0005
	b) Negative	2112-01-0006
22	Audio Knob	2410-01-0034
23	RF IN Connector	2110-00-0001
24	Calibration OUT Connector	2110-06-1005
25	Calibration Set Control	4610-14-8253
26	Intensity Knob	2410-01-0034
27	Horizontal Gain Control	4610-02-1503
28	Horizontal Pos. Control	4610-02-1503
29	Vertical Gain Control	4610-02-1503
30	Vertical Pos. Control	4610-02-1503
31	a) Power Switch	5106-00-0031
	b) Power Switch Bezel	2810-23-0070

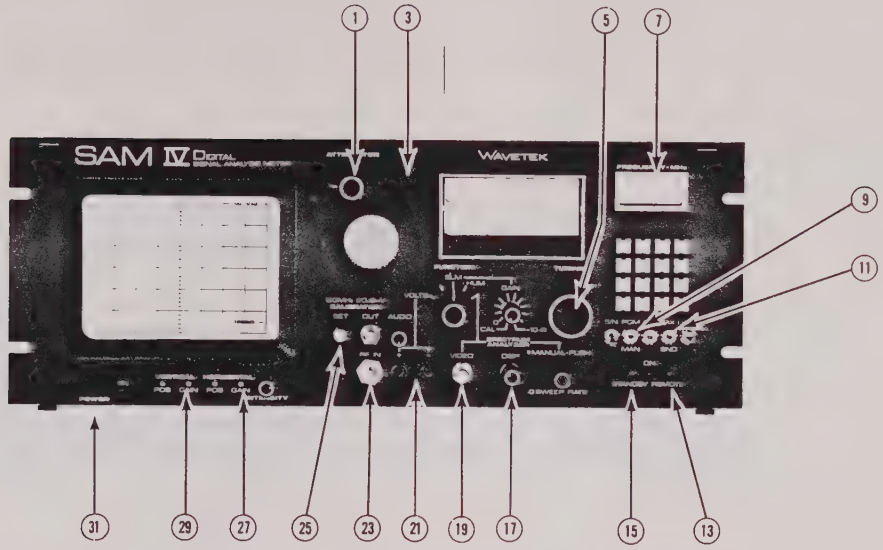
SPECIFICATIONS FOR MODEL SAM IV

SIZE	7" high x 19" wide x 12" deep
WEIGHT	20 lbs.
AC POWER REQUIREMENTS	110/220 VAC ± 10%; 50 to 60 Hz; 100W
AMPLITUDE RANGE	-40 to +60 dBmV
AMPLITUDE ACCURACY	± .5 dB
TEMPERATURE RANGE	0 to 120° F
TEMPERATURE ACCURACY	± 1 dB
FREQUENCY RANGES	4 to 450 MHz 470 to 890 MHz
SELECTIVITY	Sufficient to distinguish between two FM signals of equal amplitude 400 kHz apart. Sufficient to measure an audio carrier in the presence of an upper channel video carrier 40 dB greater in amplitude.
I.F. BANDWIDTH	280 kHz at 3 dB, 600 kHz at 40 dB point
HUM	0.5% to 5%
CALIBRATOR	
Frequency	150 MHz ±2 MHz
Amplitude	+20 dBmV ±.25 dB over temperature range
VOLTMETER	5 - 100 AC-DC 10%
SPECTRUM ANALYZER	
Amplitude Range	40 dB on screen; -40 dBmV to +60 dBmV
Frequency Range	4 MHz to 300 MHz or 4 MHz to 450 MHz
Rate	Variable 2 Hz to 40 Hz, plus manual.
Dispersion	Variable from .15 MHz
Horizontal	+.5 to +9V
Vertical	0-3V
S/N	@63 MHz ± 1 dB from 21.6 dB (factory spec)
PEAK DETECTOR	-.2 dB
AFC	Must pull up from at least 5 dB down -.5 dBmV

KEYBOARD PROGRAMMING

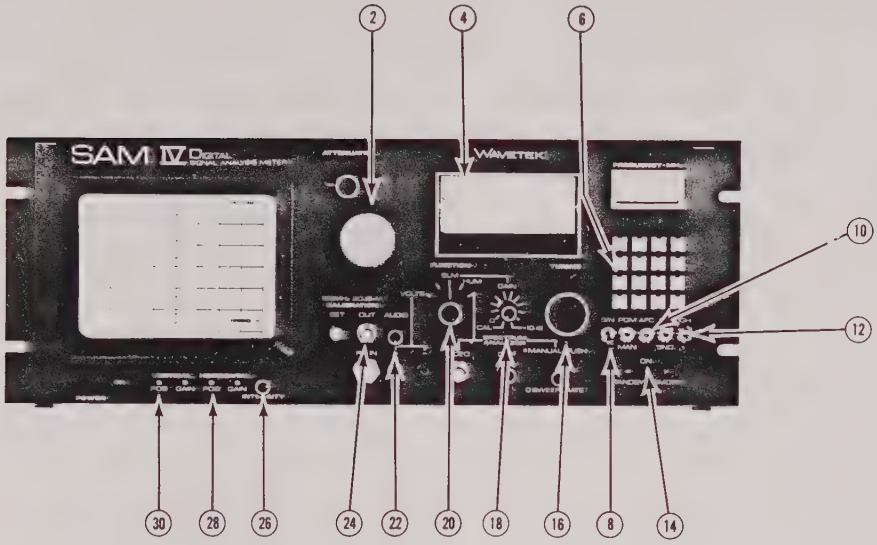
Standard Channels	VHF:Video 2 to 60 Audio 2 to 60 UHF:14 to 83
HRC Channels	Video 2 to 60 Audio 2 to 60
Frequency	Preset for 0.1 MHz steps, 4 MHz to 450 MHz, 470 to 890 MHz.

OPERATOR CONTROLS FOR MODEL SAM IV



1	ATTENUATOR CONTROL	selects the RF input level range and meter scale to be read.
3	U/V SWITCH	selects UHF or VHF frequency range when UHF option is installed.
5	TUNING CONTROL	manually selects the frequency to be measured when the PGM/MAN switch is set to MAN.
7	FREQUENCY DISPLAY	indicates the frequency selected via the keyboard or tuning control. (4 digits)
9	PGM/MAN SWITCH	enables either the keyboard or tuning control.
11	PIX/SND SWITCH	selects the video or audio carrier for measurement when a channel is programmed via the keyboard.
13	REMOTE LAMP	indicates the instrument is being programmed via the remote connector.
15	STANDBY LAMP	indicates the instrument is in "standby" mode.
17	DISP CONTROL	selects the spectrum analyzer dispersion.
19	VIDEO CONNECTOR	provides connection for the video output signal and the analyzer vertical output for an oscilloscope.
21	+/- CONNECTORS	accept test leads for voltage measurements when the function switch is set to volts.
23	RF IN CONNECTOR	provides input for the signal to be measured.

25	CALIBRATION SET CONTROL	provides output from the internal calibration to calibrate the meter for amplitude measurements.
27	HORIZONTAL GAIN CONTROL	calibrates the CRT display horizontal axis.
29	VERTICAL GAIN CONTROL	calibrates the CRT display vertical axis.
31	POWER SWITCH	applies power to the instrument.



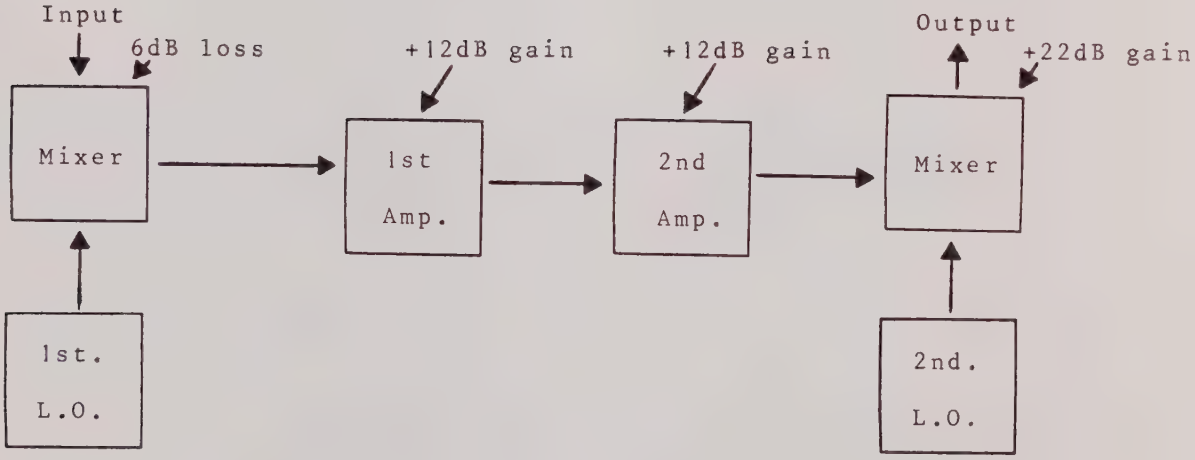
2	SPEAKER	gives audio output of demodulated signal.
4	METER	indicates value of function being measured.
6	KEYBOARD	selects the frequency or channel to be measured when the PGM/MAN switch is set to PGM.
8	S/N SWITCH	enables internal compensation for 4 MHz bandwidth noise measurements.
10	AFC SWITCH	enables the internal AFC circuit.
12	LIGHT SWITCH	provides backlighting for the meter
14	ON LAMP	indicates operation of the instrument.
16	SWEEP RATE/MANUAL CONTROL	selects between sweep and manual modes of the spectrum analyzer when the spectrum analyzer option is installed. The control selects the analyzer sweep or manual rate.
18	GAIN CONTROL	provides 0 to 10 dB of level adjustment when the function switch is set to SLM (signal level meter mode).
20	FUNCTION SWITCH	selects the function to be measured.
22	AUDIO CONTROL	enables the internal audio circuit and adjusts the volume of the speaker output.

24	CALIBRATION OUT CONNECTOR	provides output from the internal calibrator to calibrate the meter for amplitude measurements.
26	INTENSITY CONTROL	adjusts the intensity of the CRT display.
28	HORIZONTAL POSITION CONTROL	adjusts the horizontal positioning of the display trace.
30	VERTICAL POSITION CONTROL	adjusts the vertical positioning of the display trace.

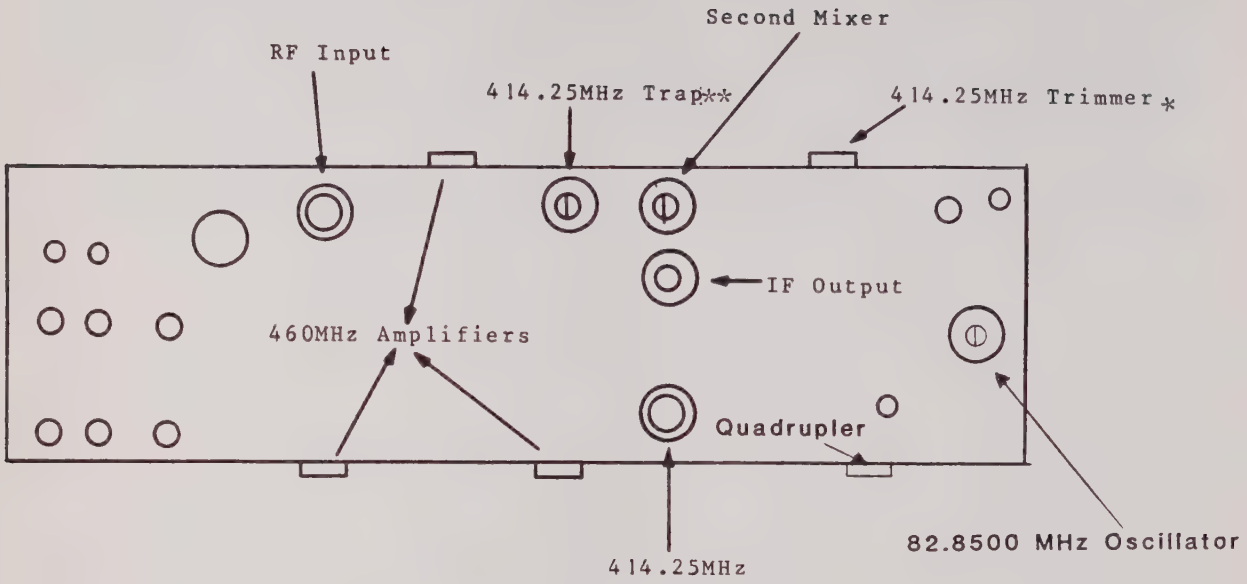
R F ASSEMBLY

The R.F. assembly is a frequency converter which converts all tuning ranges of the SAM to a common output of 45.75MHz. The I.F. consists of a 1st L.O. which uses varactor tuning to feed the mixer with the incoming signal. The output of the mixer is 460MHz. Two stages of I.F. amplification follow the mixer with about +12 dB of gain each. This amplified 460MHz signal is then fed to another mixer circuit which is coupled to the 2nd L.O. (414.25) for a common output frequency of 45.75MHz and is connected to the input of the main board I.F.

Some units have UHF coverage by using a added UHF tuning board (1st L.O.). Also, the 2nd L.O. maybe crystal controlled, rather than the standard tuneable oscillator.



R.F ASSEMBLY



* This trimmer is used to adjust a 414.25MHz trap. This trap keeps the 2nd L.O. signal from feeding back into the IF which could cause a spur to occur at 414.25MHz. Only adjust this trimmer if the Sam indicates a signal at 414.25MHz, when no signal is applied to the Sam RF in" on the front panel.

RF SPECIFICATIONS

TYPE	GAIN	SWEEP WIDTH
Jr. 300	+36 dB - +40 dB	-12 - 310 MHz
Jr. 400	+36 dB - +40 dB	-12 - 410 MHz
Jr. 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
Jr. 450	+36 dB - +40 dB	-12 - 460 MHz
I 300	+36 dB - +40 dB	-12 - 310 MHz
I 400	+36 dB - +40 dB	-12 - 410 MHz
I450	+36 dB - +40 dB	-12 - 460 MHz
I 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
I 450 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
II 300	+36 dB - +40 dB	-12 - 310 MHz
II 400	+36 dB - +40 dB	-12 - 410 MHz
II 450	+36 dB - +40 dB	-12 - 460 MHz
II 300	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
III 450	+36 dB - +40 dB	-12 - 460 MHz
III UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
IV 450	+36dB - +40 dB	-12 - 460 MHz
IV UHF	VHF +36dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz

NOTE

All of these RF specifications include units with the analyzer option.

RF TROUBLESHOOTING

Before taking voltage readings in the RF itself, be sure proper voltages are being supplied to the RF.

There is 12 V supplied to the oscillator board along with varactor drive 0 to 12 volts for tuning.

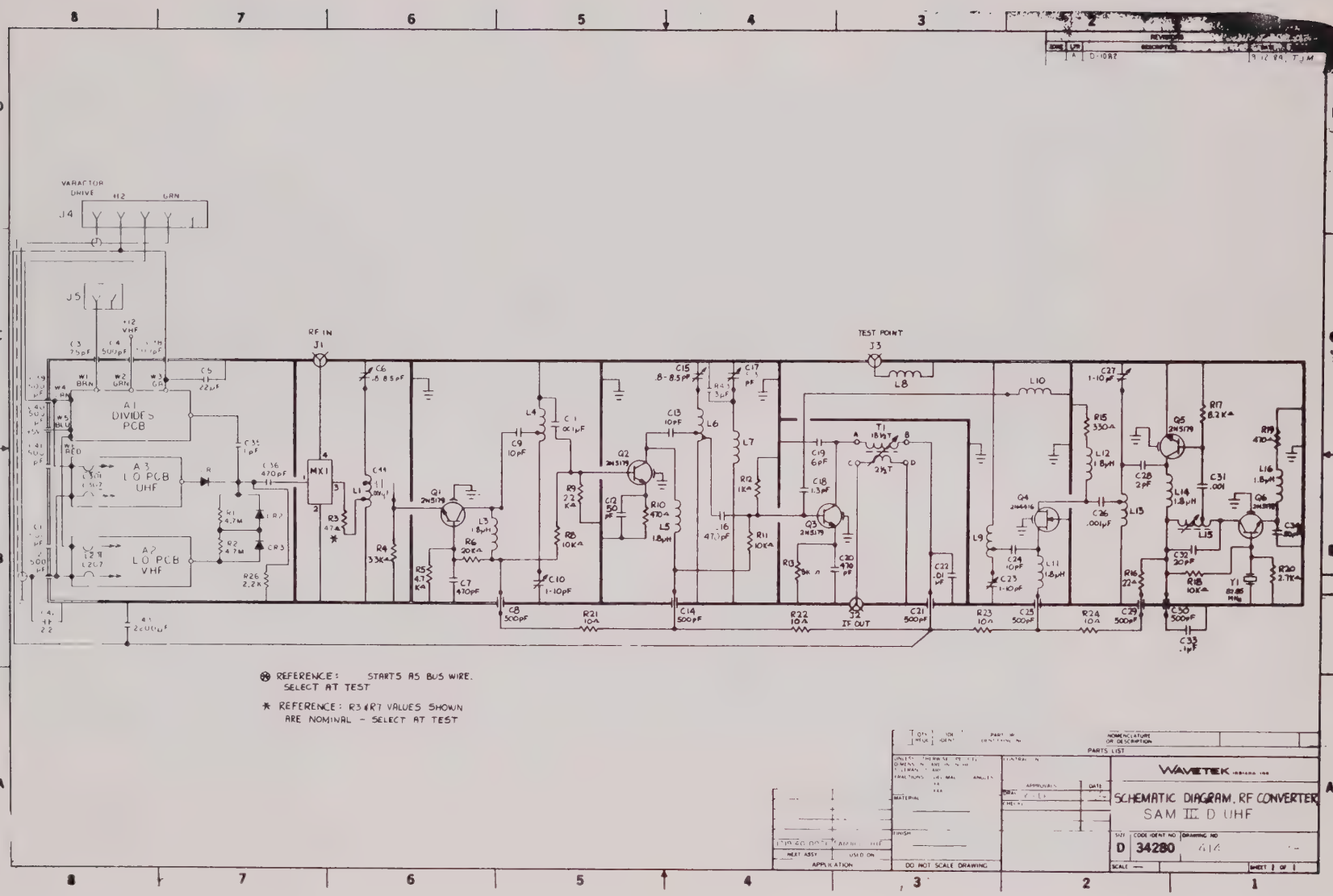
The first IF amp. transistor is a 5179 and should read approximately 1.6 volts on the emitter, 2.4 volts on the base, and 12 volts on the collector.

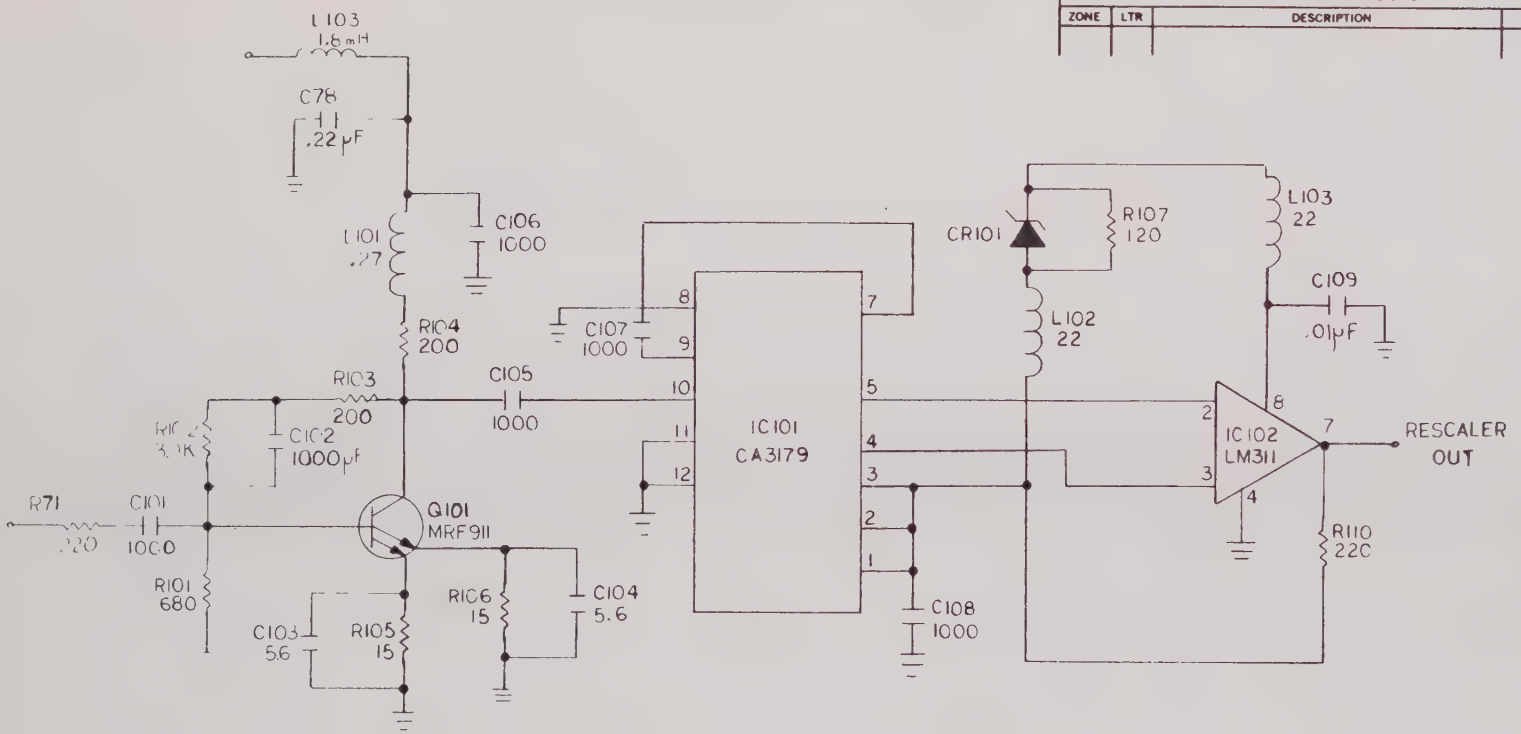
The second IF amp. transistor is also a 5179 which is coupled to the first amp. stage by its base and should read 2.2 volts, 1.3 volts for the emitter and 12 volts for the collector.

In the output mixer stage, a 5179 transistor is used. There should be 1.07 volts on the base which is connected to the 2nd amp. stage by a 470 pf. cap. The emitter should read .3 to .7 volts. The collector is supplied by 12 volts.

The second L.O. (not crystal controlled) uses a 4416 transistor. There should be 12 volts on the collector and 1.5 volts on the base.

If all voltages in the RF are correct, but it still does not meet gain, sweep, or flatness specs, the SAM should be returned to Wavetek for repair and calibration.


VARACTOR DRIVE
J4
J5
A1 DIVIDER PCB
A3 LO PCB UHF
A2 LO PCB VHF
RF IN
J1
MX1
TEST POINT
J3
IF OUT
J2
L8
L10
Q1 2N5179
Q2 2N5179
Q3 2N5179
Q4 2N4416
Q5 2N5179
Q6 2N5179
T1
REFERENCE: STARTS AS BUS WIRE. SELECT AT TEST
* REFERENCE: R3 & R7 VALUES SHOWN ARE NOMINAL - SELECT AT TEST
WAVETEK
SCHEMATIC DIAGRAM, RF CONVERTER
SAM III D UHF
34280
PARTS LIST
DO NOT SCALE DRAWING



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN TJM	6-17
CHECKED	

WAVETEK INDIANA, INC

SAM III
DIVIDE BY 256

SIZE	CODE IDENT NO.	DRAWING NO.
B	34280	

SCALE | SHEET OF

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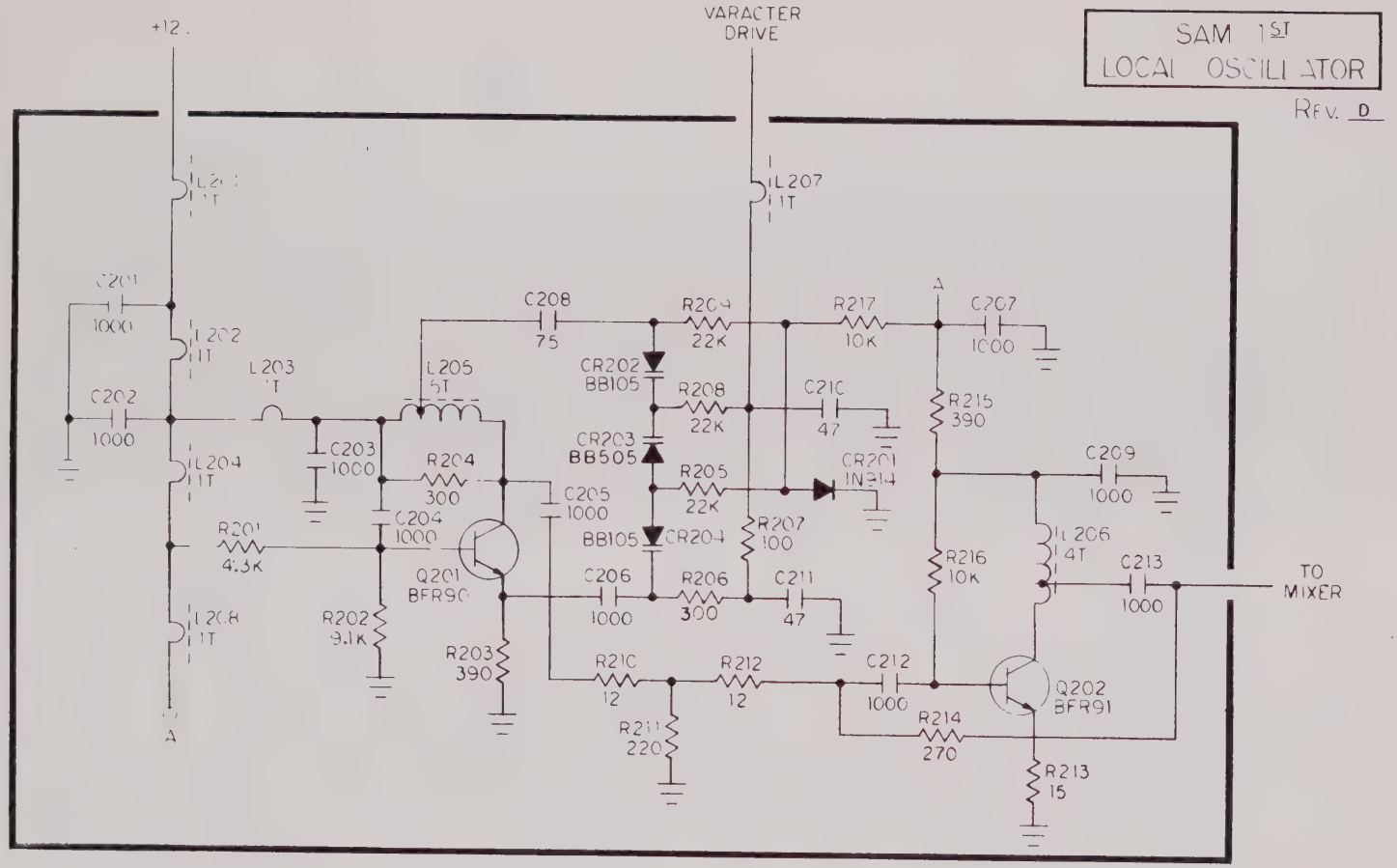
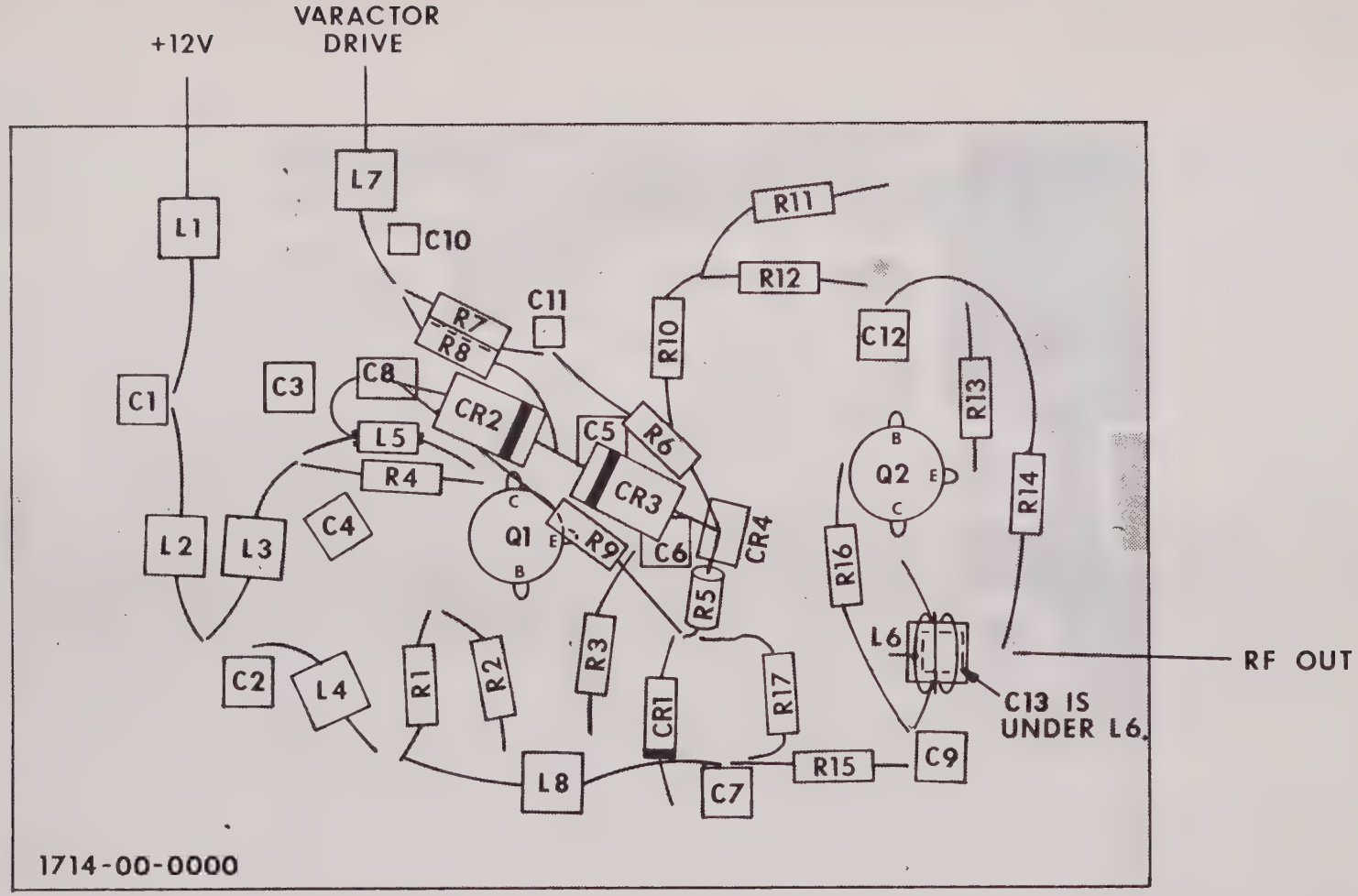
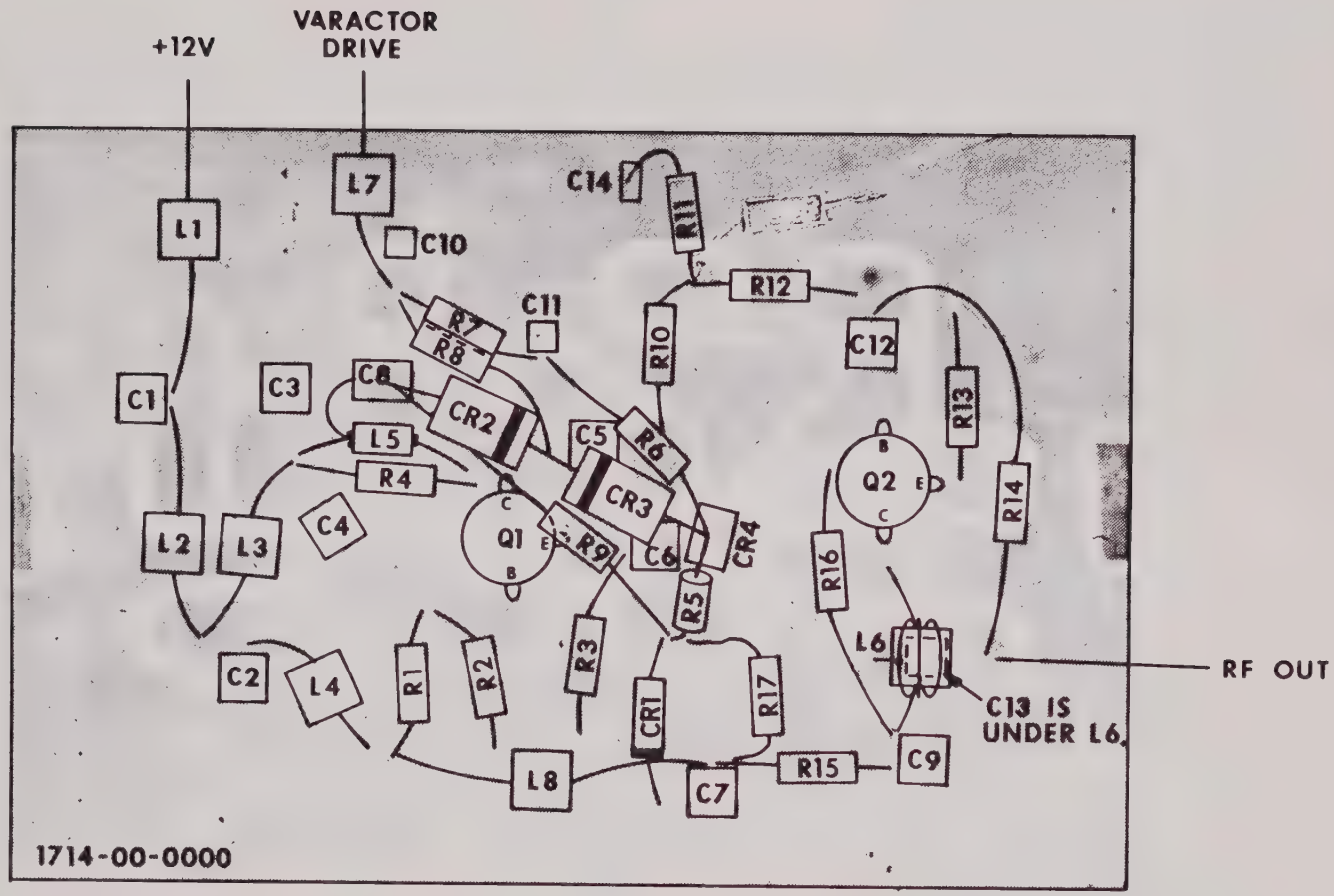
TELEDYNE POST N28549



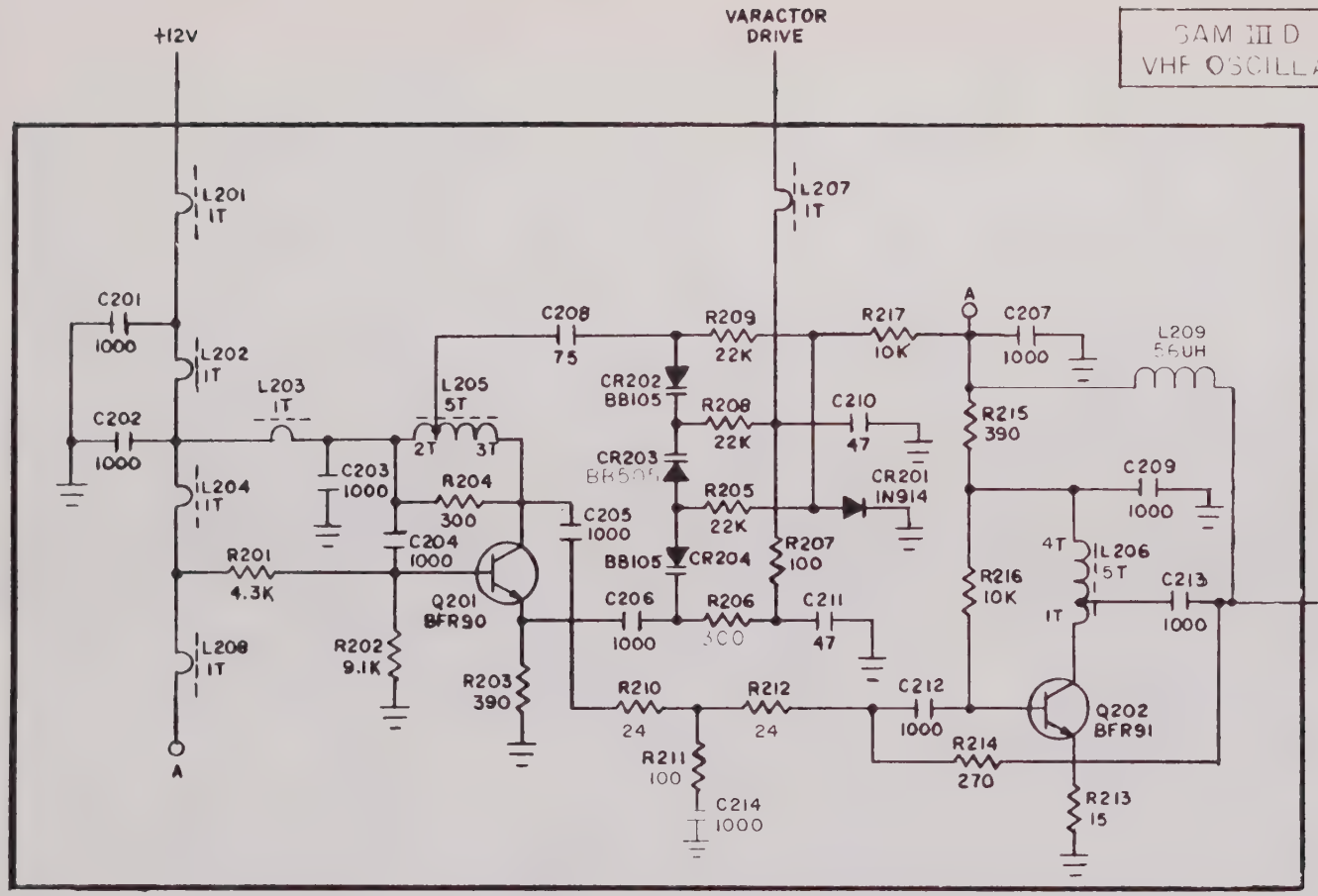
REVISIONS			WAVETEK INDIANA		
	ECN'S	BY			
A	D 018	. .	SAM 1st LOCAL OSCILLATOR		
B	C034	G.L.R.			
C	D-09	W.F.	DRAWN BY	DATE	NUMBER
D	D 1021	WP	D. J WATSON	3-16-82	0414-10-0001
E			APP'D		



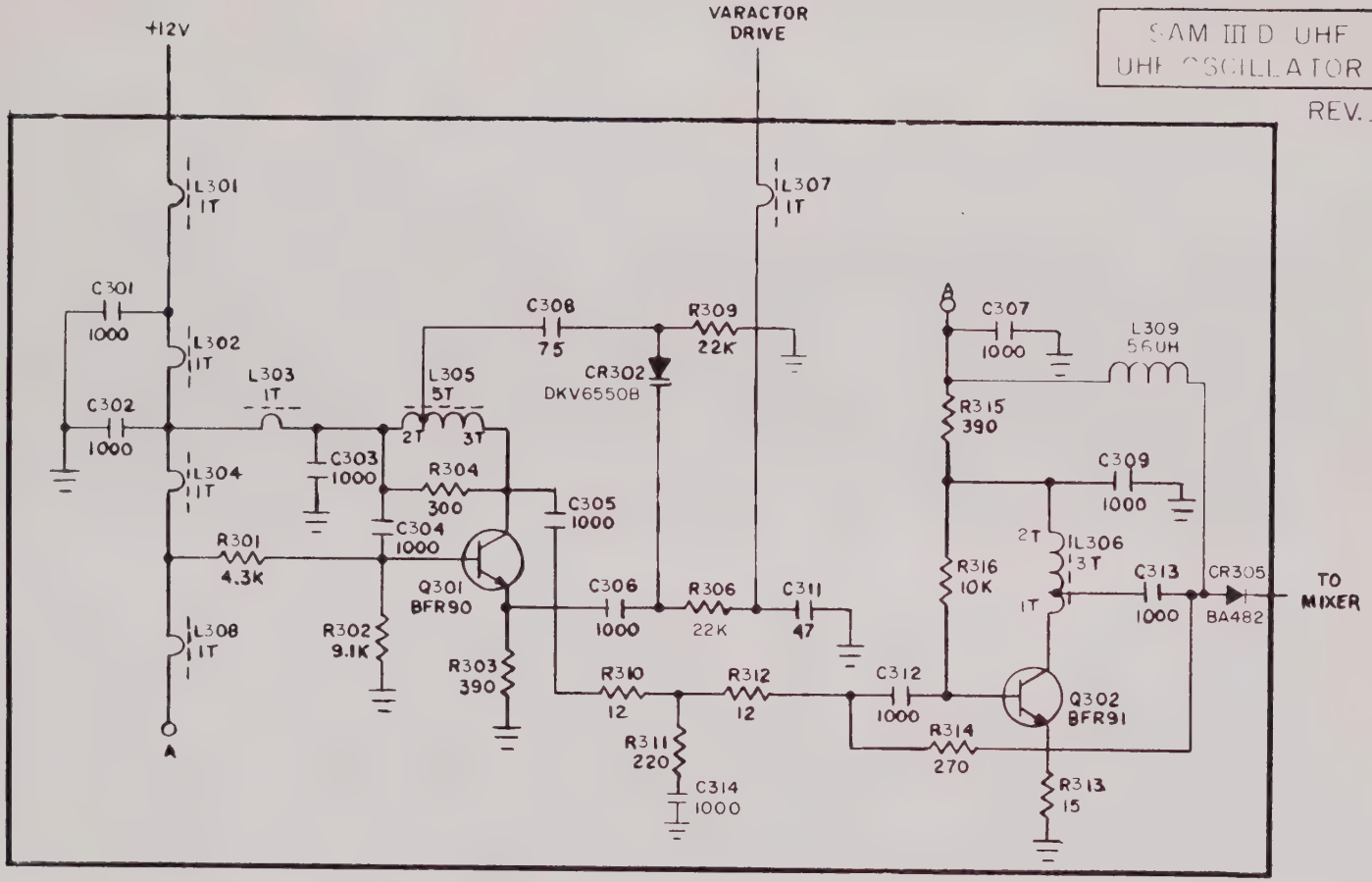
ALL REF. DES. ARE 200 SERIES



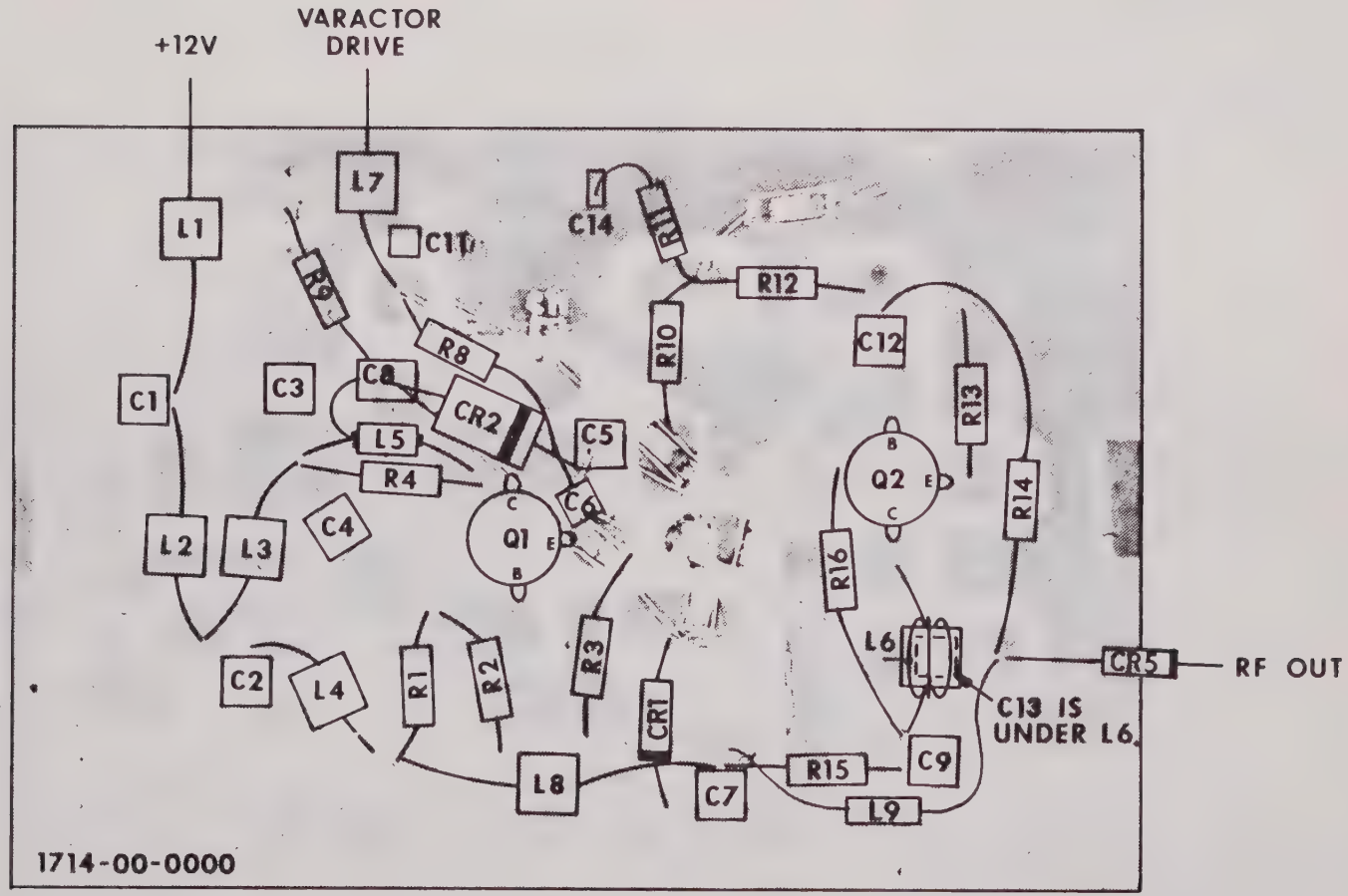
ALL REF. DES. ARE 200 SERIES



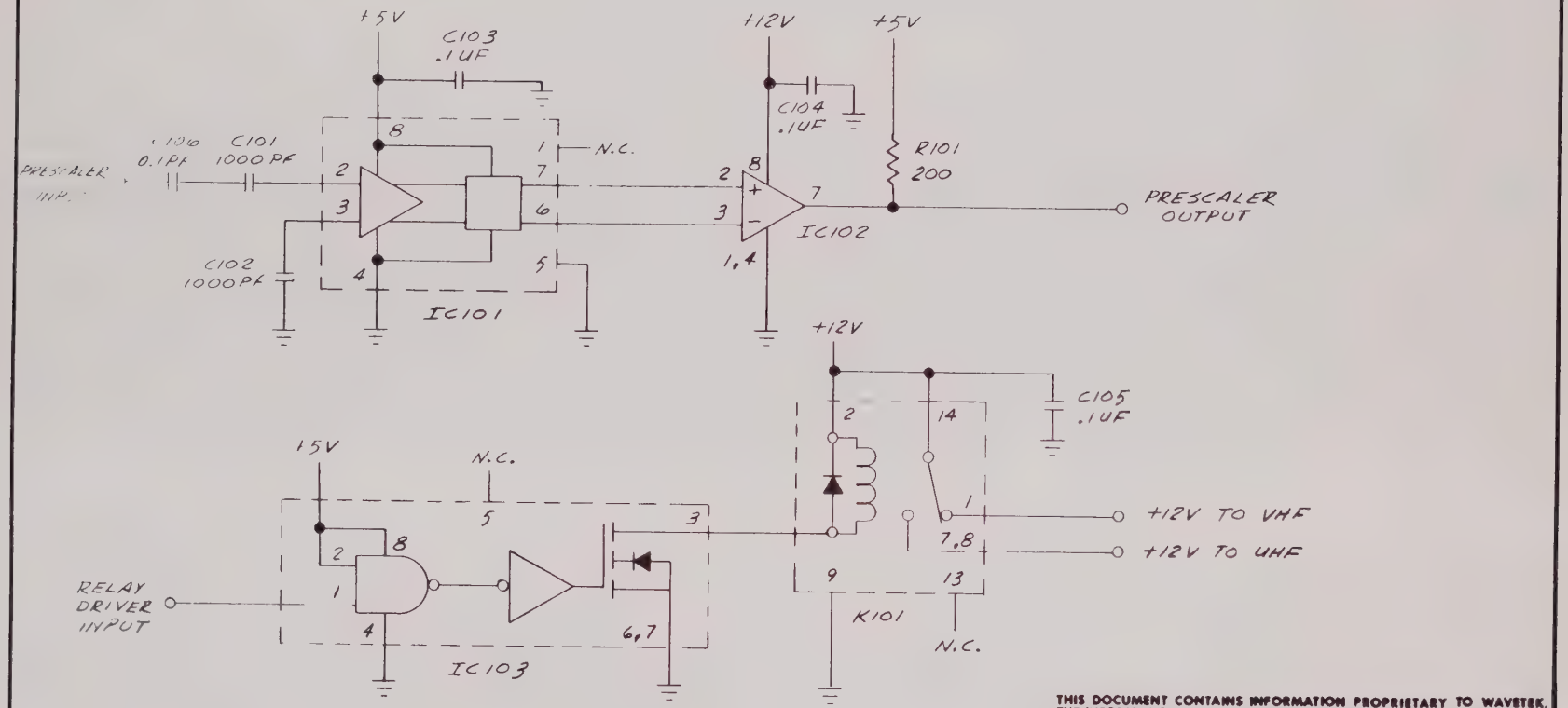
REVISIONS			WAVETEK
	ECN'S	BY	
A	D063	JL	SCHEMATIC, VHF OSCILLATOR PCB
B	D074	JL	
C	D-092	W.P.	DRAWN BY: BRYNAN; DATE: 2-1-83; NUMBER: 0414-10-9015
D	D-1021	W.P.	
E	D 1027	W.P.	APP'D: 2/4/83



REVISIONS			WAVETEK
	ECN'S	BY	
A	D074	JL	SCHEMATIC, UHF OSCILLATOR PCB
B	D-1027	WP	
C			DRAWN BY: ERYNAN; DATE: 2-1-83; NUMBER: 0414-10-9014
D			
E			APP'D



ALL REF. DES. ARE 200 SERIES



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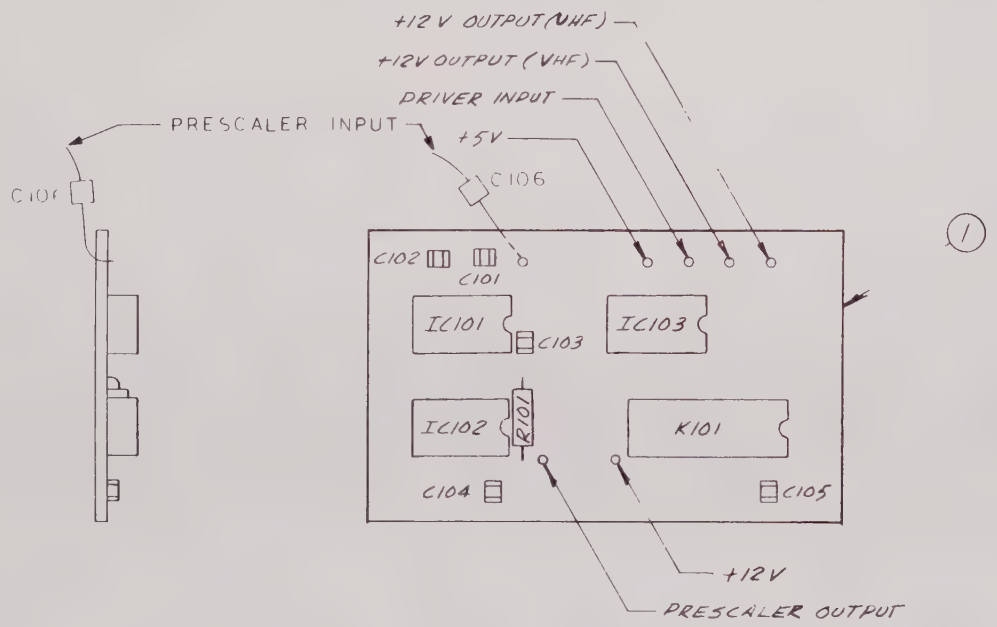
MATERIAL:	WAVETEK INDIANA		
	SCHEMATIC, PRESCALER PCB		
FINISH:	DRAWN BY: BRYNAN	SCALE: —	DATE: 1-28-83
	CHK'D:	DATE: 2/14/83	DRAWING NO.
ARTWORK #	RELEASED BY	DATE	0414-10-9013

TOLERANCE:
DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED

NO.	DESCRIPTION	BY
REVISION		



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MATERIAL: SEE P/L 1218-40-9017	WAVETEK INDIANA		
	ASSY DWG, PRESCALER PCB		
FINISH:	DRAWN BY: BRYNAN	SCALE: 2X	DATE: 1-28-83
ARTWORK #	CHK'D: [signature]	DATE: 2/4/83	DRAWING NO.: 0412-10-9025
	RELEASED BY	DATE	

TOLERANCE:
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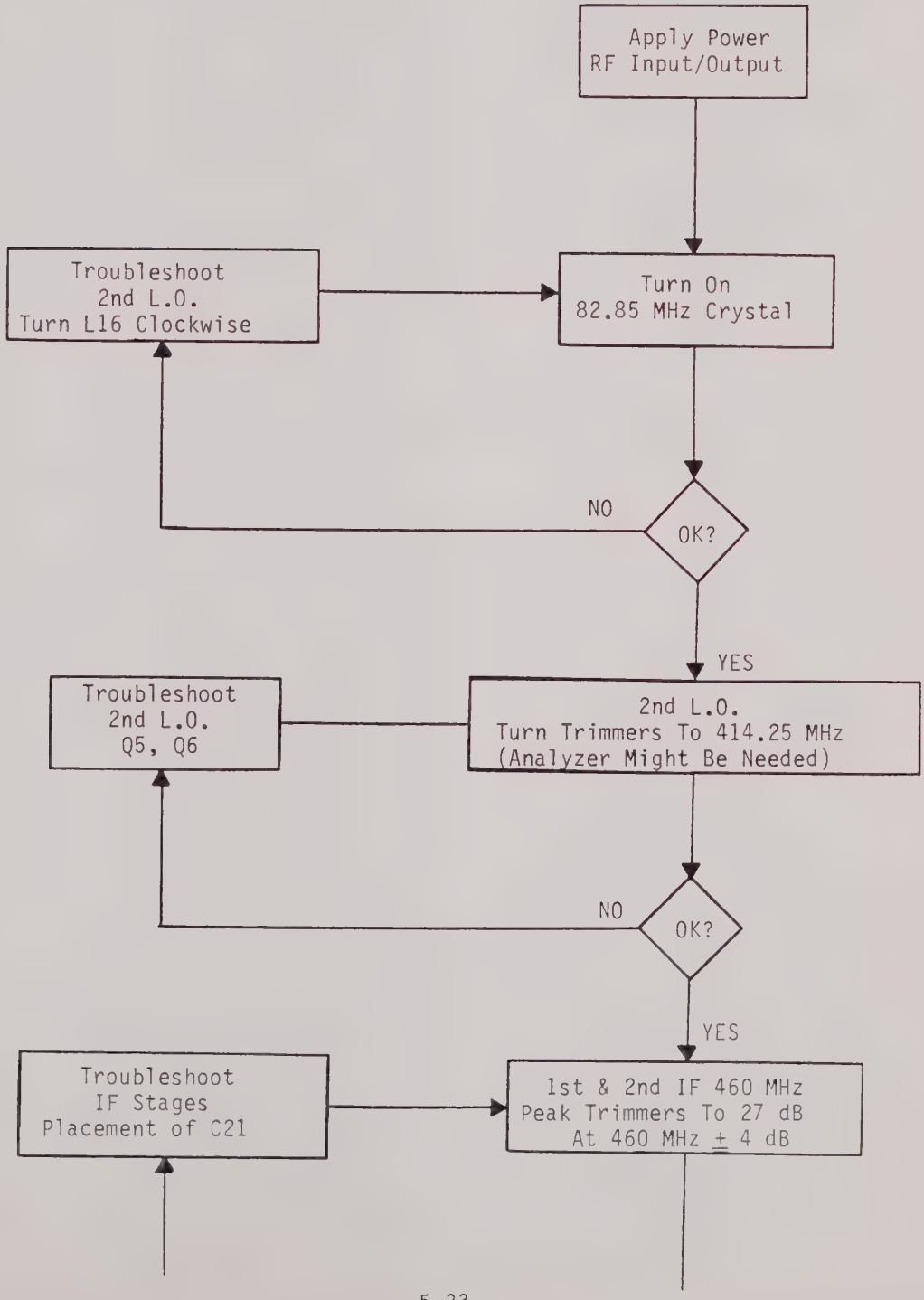
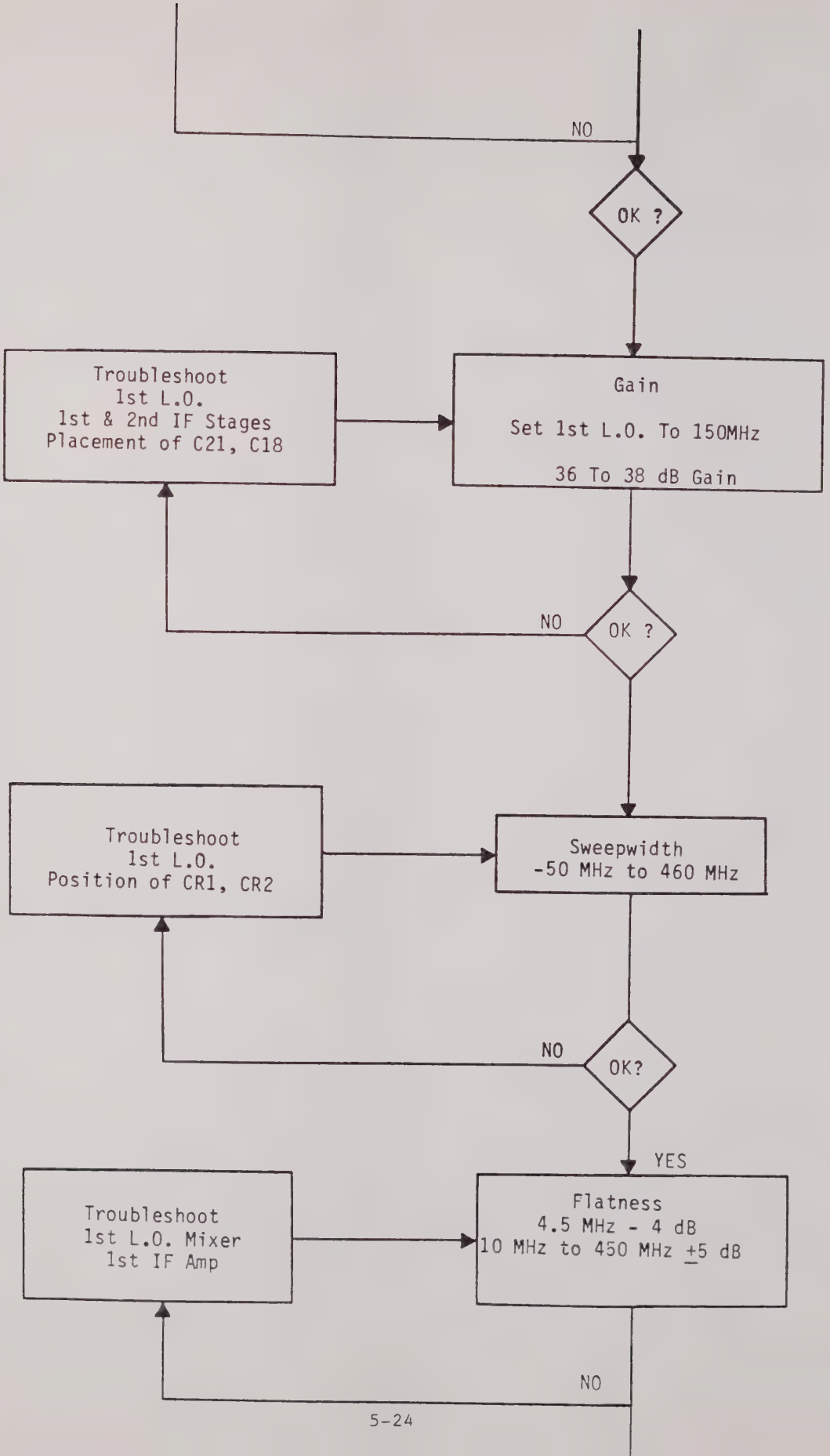
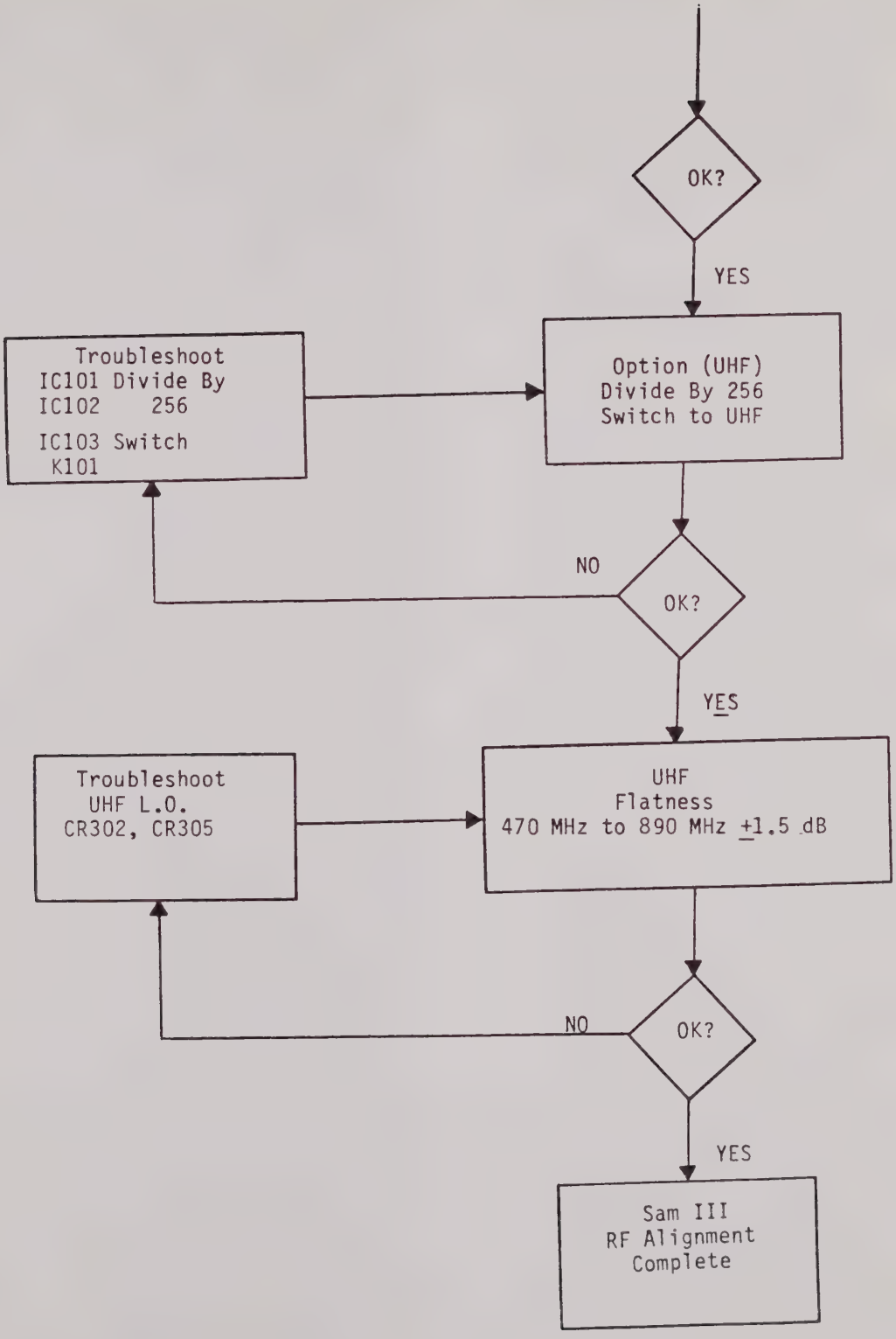
NO.	DESCRIPTION	BY
	REVISION	

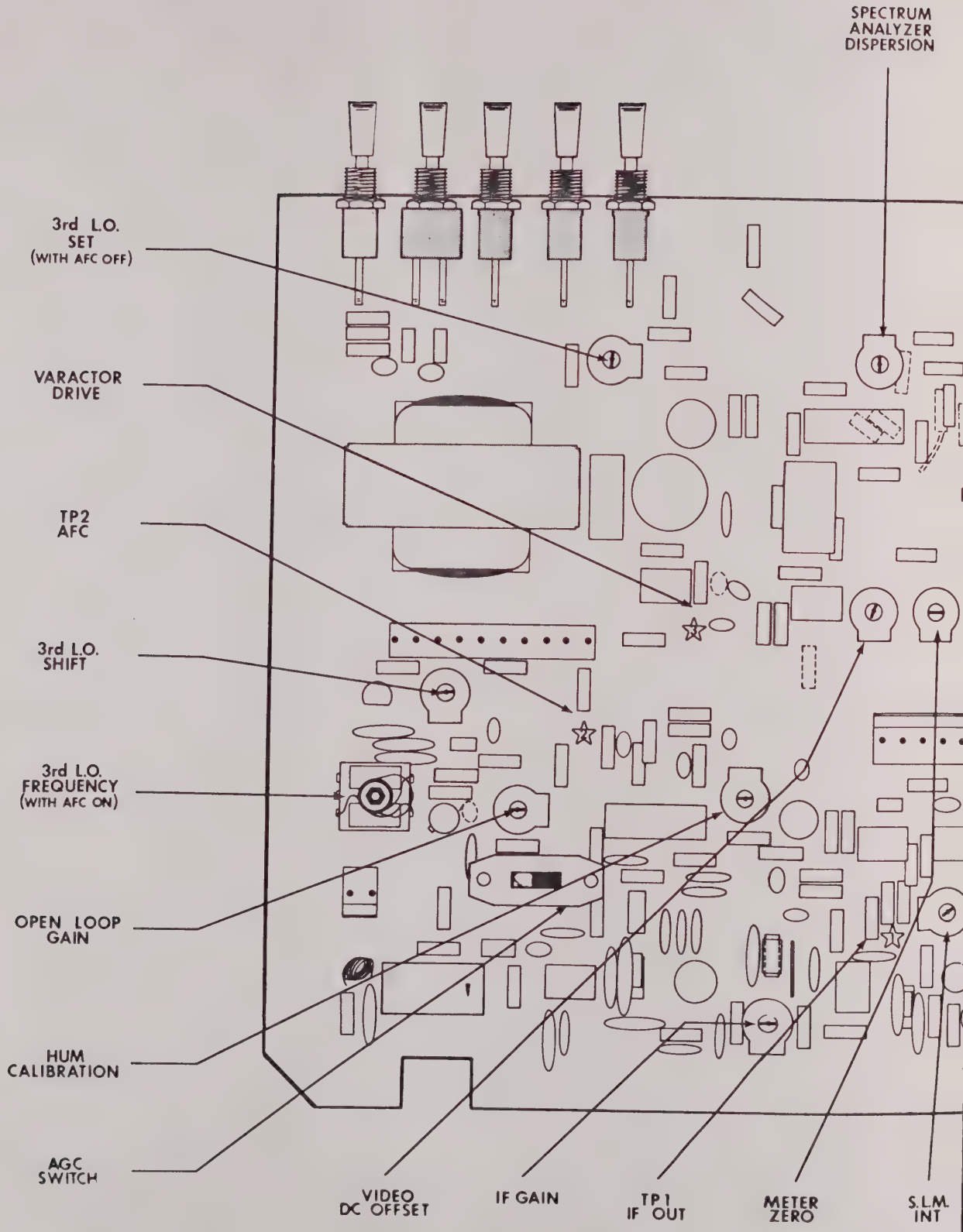
SAM IV RF HEAD ALIGNMENT

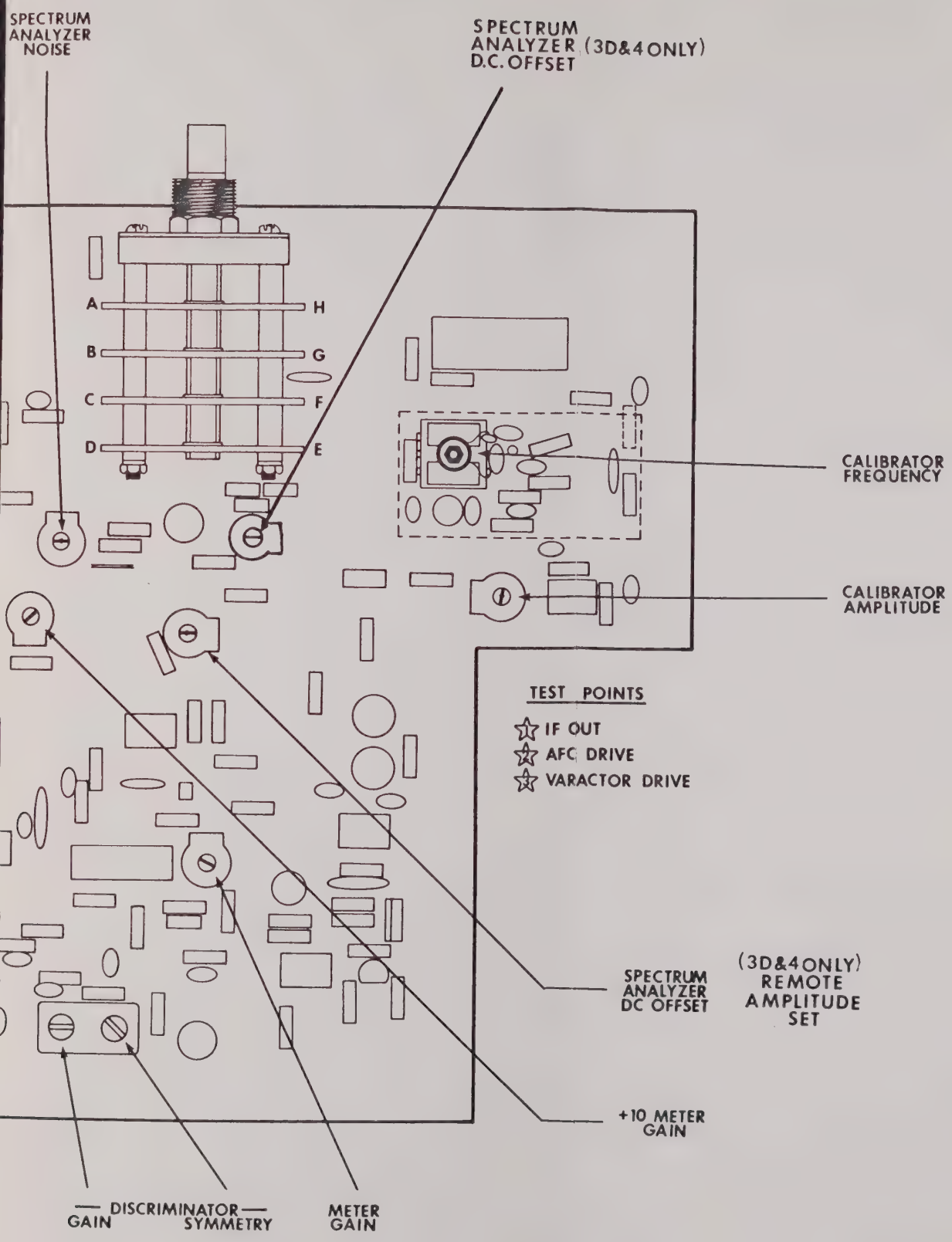
(Generalized)

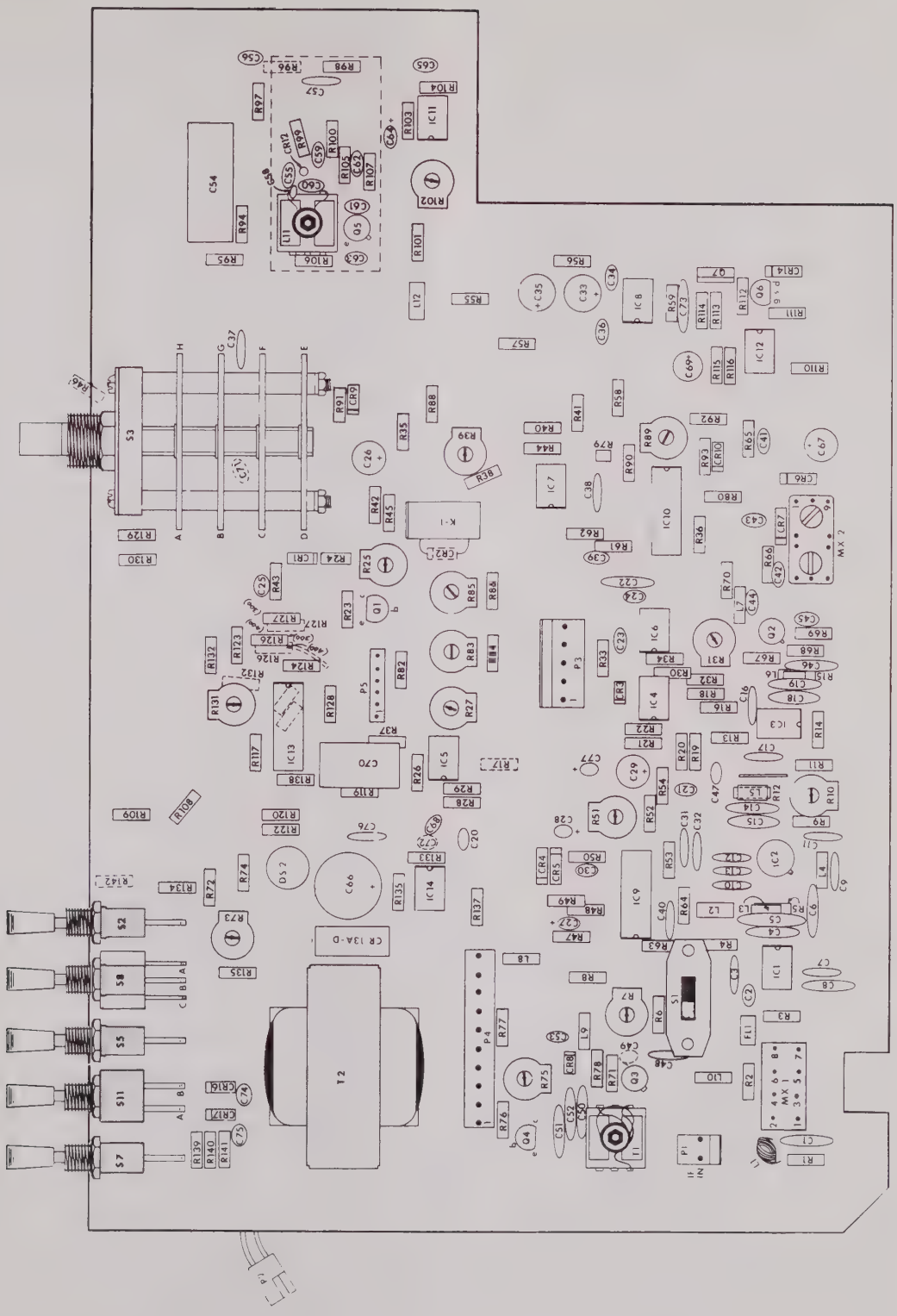


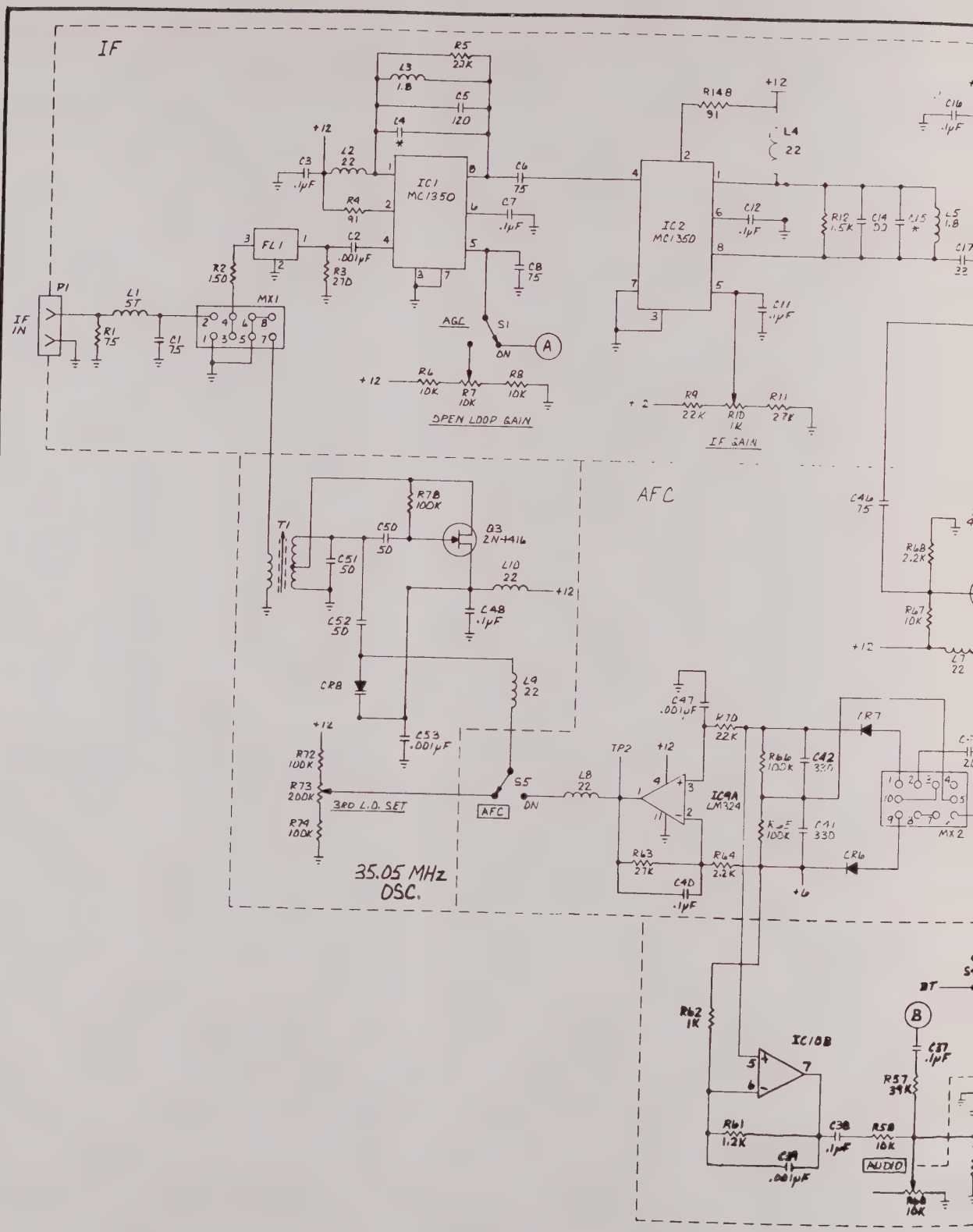

NO
OK ?
Troubleshoot
1st L.O.
1st & 2nd IF Stages
Placement of C21, C18
Gain
Set 1st L.O. To 150MHz
36 To 38 dB Gain
NO
OK ?
Troubleshoot
1st L.O.
Position of CR1, CR2
Sweepwidth
-50 MHz to 460 MHz
NO
OK?
YES
Troubleshoot
1st L.O. Mixer
1st IF Amp
Flatness
4.5 MHz - 4 dB
10 MHz to 450 MHz ±5 dB
NO

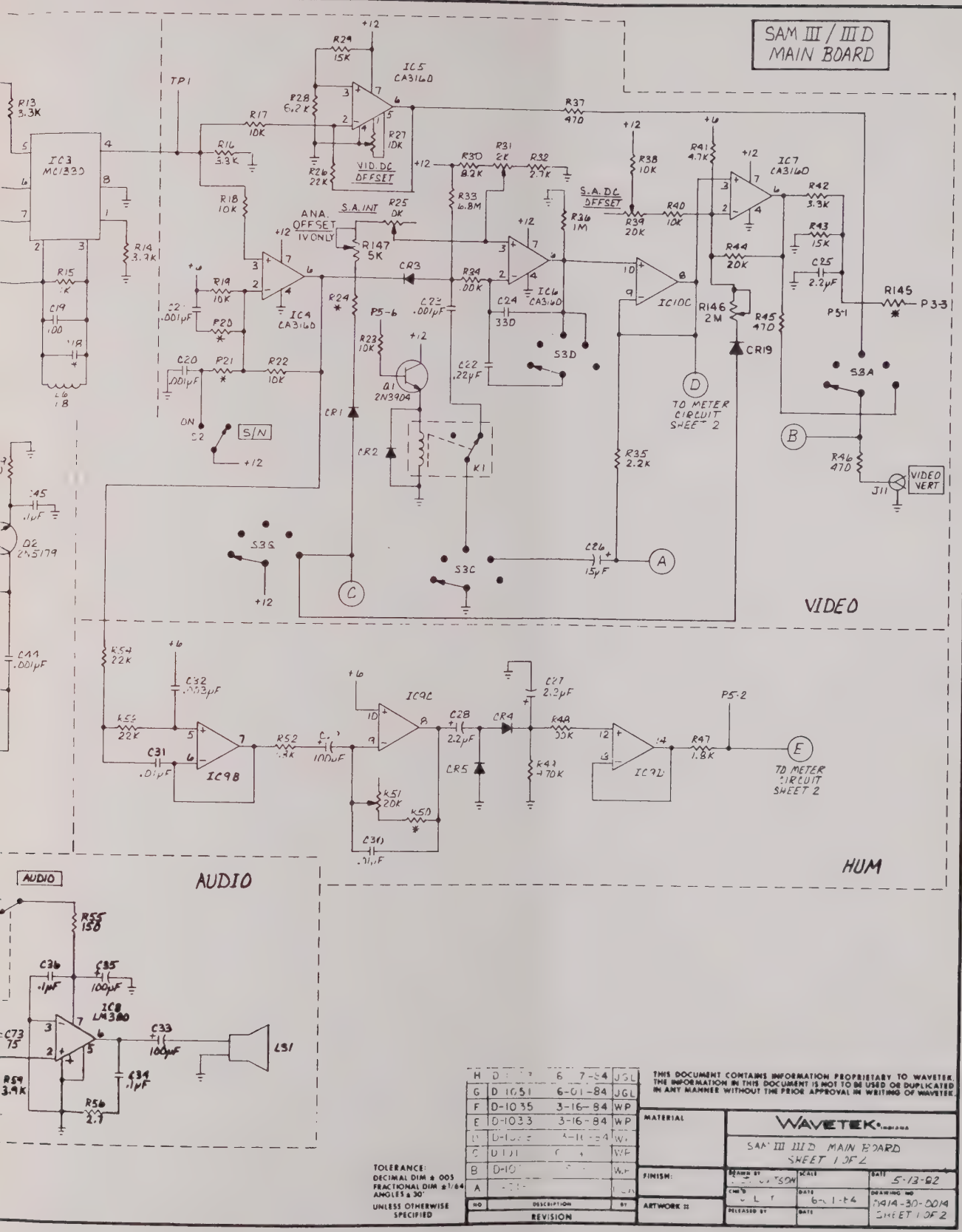

OK?
YES
Troubleshoot
IC101 Divide By
IC102 256
IC103 Switch
K101
Option (UHF)
Divide By 256
Switch to UHF
NO
OK?
YES
Troubleshoot
UHF L.O.
CR302, CR305
UHF
Flatness
470 MHz to 890 MHz ±1.5 dB
NO
OK?
YES
Sam III
RF Alignment
Complete


SPECTRUM ANALYZER DISPERSION
3rd L.O. SET (WITH AFC OFF)
VARACTOR DRIVE
TP2 AFC
3rd L.O. SHIFT
3rd L.O. FREQUENCY (WITH AFC ON)
OPEN LOOP GAIN
HUM CALIBRATION
AGC SWITCH
VIDEO DC OFFSET
IF GAIN
TP1 IF OUT
METER ZERO
S.L.M. INT


SPECTRUM ANALYZER NOISE
SPECTRUM ANALYZER D.C. OFFSET (3D&4 ONLY)
A
B
C
D
H
G
F
E
CALIBRATOR FREQUENCY
CALIBRATOR AMPLITUDE
TEST POINTS
IF OUT
AFC DRIVE
VARACTOR DRIVE
SPECTRUM ANALYZER DC OFFSET
(3D&4 ONLY) REMOTE AMPLITUDE SET
+10 METER GAIN
GAIN
DISCRIMINATOR SYMMETRY
METER GAIN




IF
AFC
IF IN
P1
L1 5T
R1 75
C1 75
MX1
FL1
R2 150
R3 270
C2 .001μF
C3 .1μF
L2 22
IC1 MC1350
R4 91
L3 1.8
R5 22K
C4 *
C5 120
C6 75
C7 .1μF
C8 75
AGC
S1
ON
A
+12
R6 10K
R7 10K
R8 10K
OPEN LOOP GAIN
R148 91
L4 22
IC2 MC1350
C12 .1μF
C11 .1μF
R12 1.5K
C14 33
C15 *
L5 1.8
C16 .1μF
C17 22
R9 22K
R10 1K
R11 27K
IF GAIN
C46 75
R68 2.2K
R67 10K
L7 22
T1
R78 100K
C50 50
C51 50
C52 50
Q3 2N4416
L10 22
C48 .1μF
CR8
L9 22
C53 .001μF
R72 100K
R73 200K
R74 100K
3RD L.O. SET
S5
AFC
DN
35.05 MHz OSC.
L8 22
TP2
C47 .001μF
R70 22K
IC9A LM324
R66 100K
C42 330
R65 100K
C41 330
R63 27K
R64 2.2K
C40 .1μF
CR7
CR6
MX2
+6
R62 1K
IC10B
R61 1.2K
C39 .001μF
C38 .1μF
R58 10K
AUDIO
C37 .1μF
R57 39K
R60 10K
B



H	D [illegible]	6 7-84	JGL
G	D 1051	6-01-84	JGL
F	D-1035	3-16-84	WP
E	D-1033	3-16-84	WP
D	D-[illegible]	[illegible]-84	WP
C	D 1031	[illegible]	WP
B	D-10[illegible]	[illegible]	WP
A	[illegible]	[illegible]	[illegible]
NO	DESCRIPTION		BY

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MATERIAL

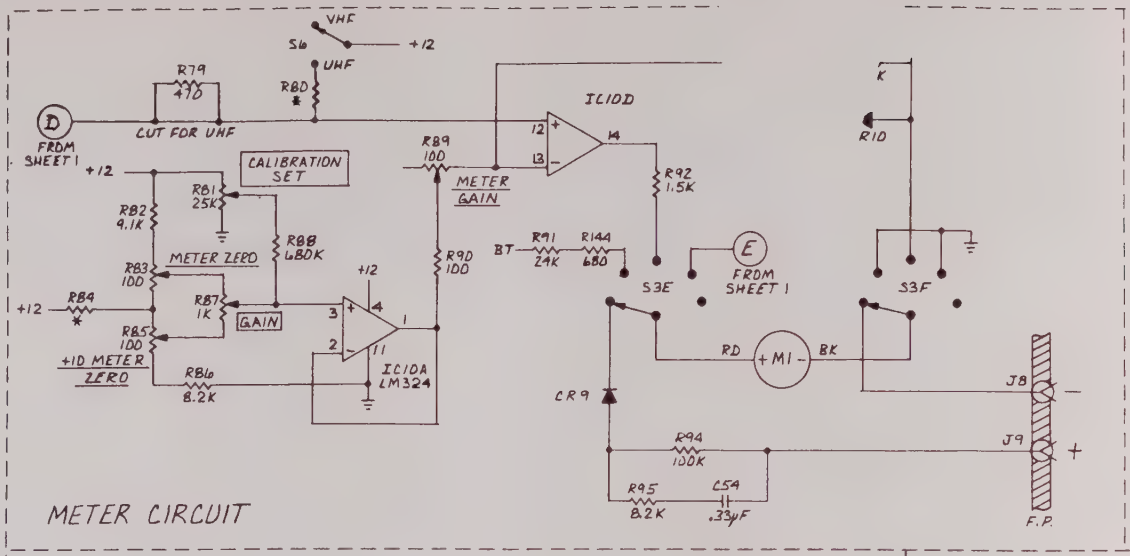
FINISH:

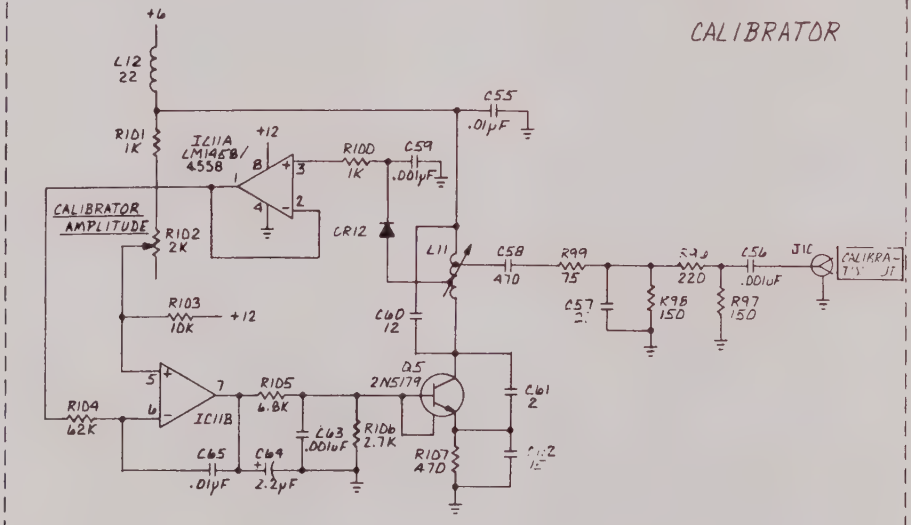
ARTWORK #

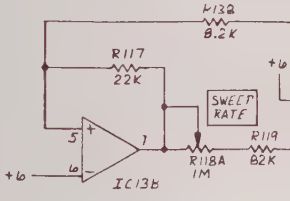
WAVETEK INDIANA

SAM III IIID MAIN BOARD
SHEET 1 OF 2

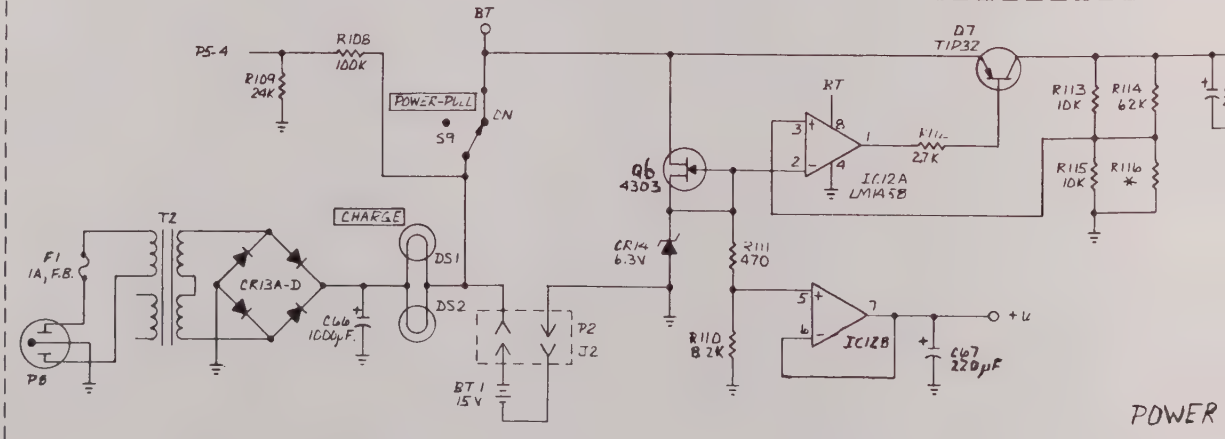
DRAWN BY [illegible] TSON	SCALE	DATE 5-13-82	
CHK'D V. L. T	DATE 6-1-84	DRAWING NO 9414-30-0014 SHEET 1 OF 2	
RELEASED BY	DATE		





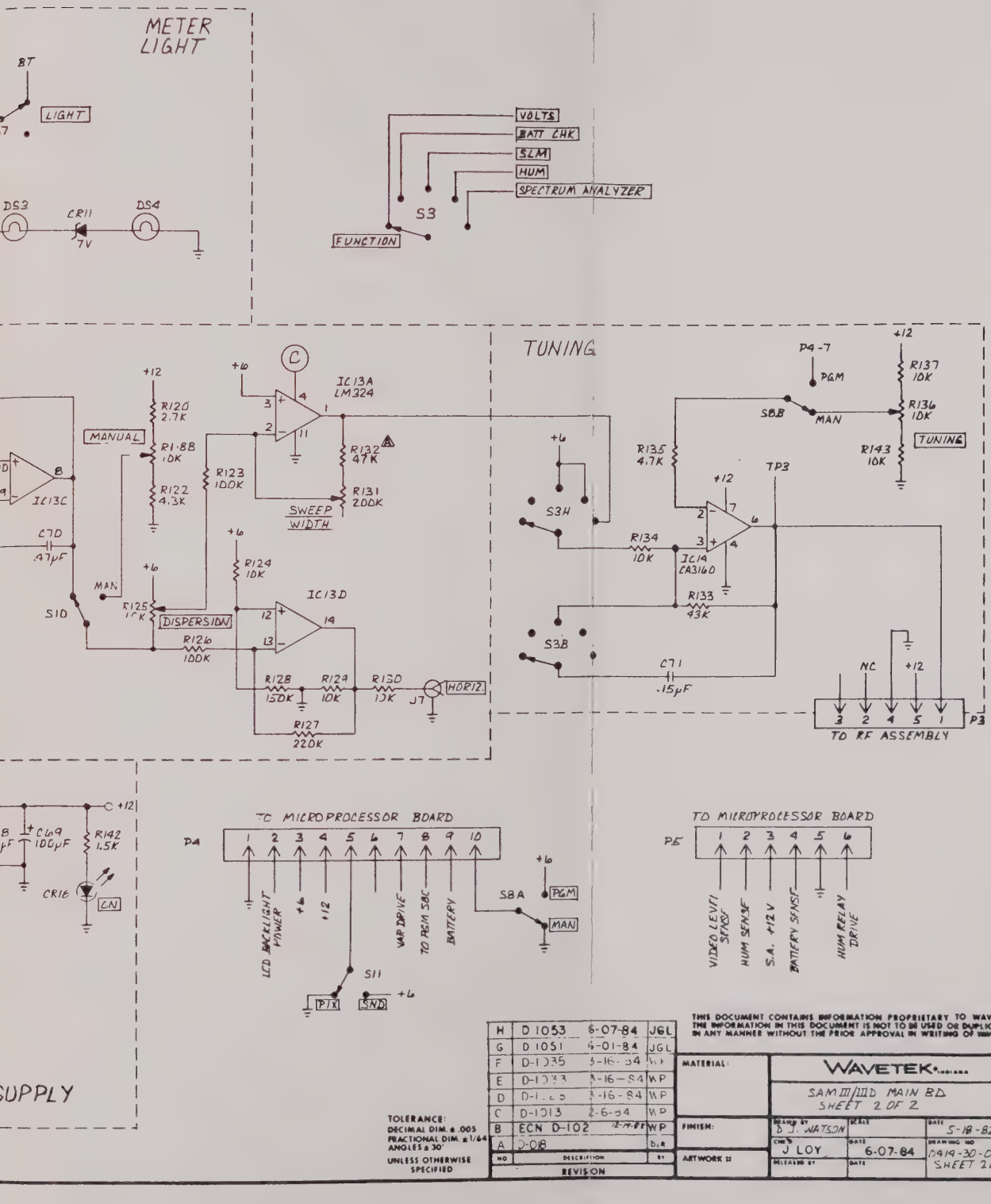


SPECTRUM ANALYZER



POWER

SAM III / III D
MAIN BOARD.



NO	DESCRIPTION	BY
H	D 1053 6-07-84	JGL
G	D 1051 6-01-84	JGL
F	D-1035 5-16-84	WP
E	D-1033 5-16-84	WP
D	D-1029 5-16-84	WP
C	D-1013 2-6-84	WP
B	ECN D-102 12-7-83	WP
A	D-08	D.A.

REVISION

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ANGLES ± 30'
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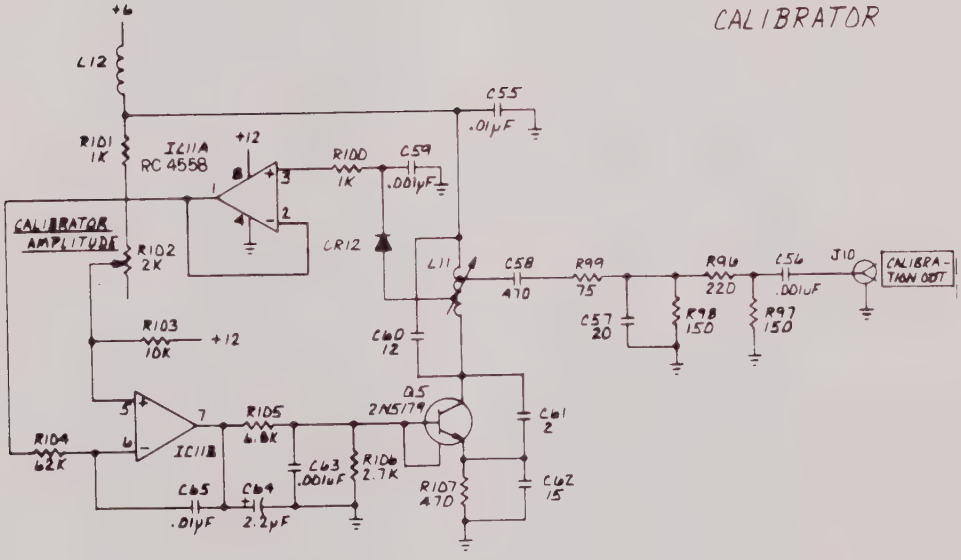
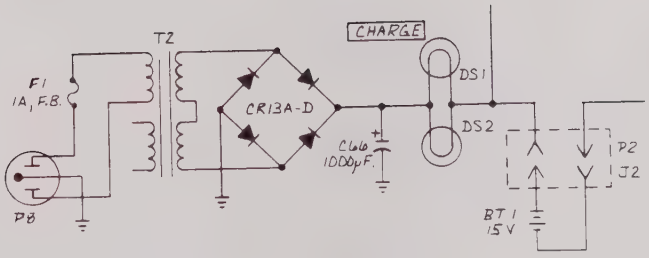
MATERIAL:	WAVETEK		
	SAM III/IIID MAIN BD. SHEET 2 OF 2		
FINISH:	DRAWN BY D. J. WATSON	SCALE	DATE 5-18-82
	CHK'D J LOY	DATE 6-07-84	DRAWING NO 0919-30-0019 SHEET 2 OF 2
ARTWORK #	RELEASED BY	DATE	

Q5 is configured as a common base oscillator. The feedback is accomplished through C61. C60 and L11 form the frequency determining tank circuit. CR12 and C59 detect a sample of the output. This detected voltage is then buffered by IC11A and applied to a comparator IC11B. R101, R102, and R103 provide a reference voltage that is also applied to a comparator IC11B. If the output level of the oscillator decreases, the detected voltage decreases causing the voltage on the inverting port of the comparator to decrease. This decrease in voltage causes the output of the comparator to increase. Since this voltage supplies the base bias, the transistor is driven harder, thus causing the amplitude of the oscillator to increase. This action provides a very stable closed loop leveling of the oscillator amplitude. C58 couples the output of the oscillator to a 75 ohm attenuator pad. The output at +20 dBmV is connected to the front panel F connector.



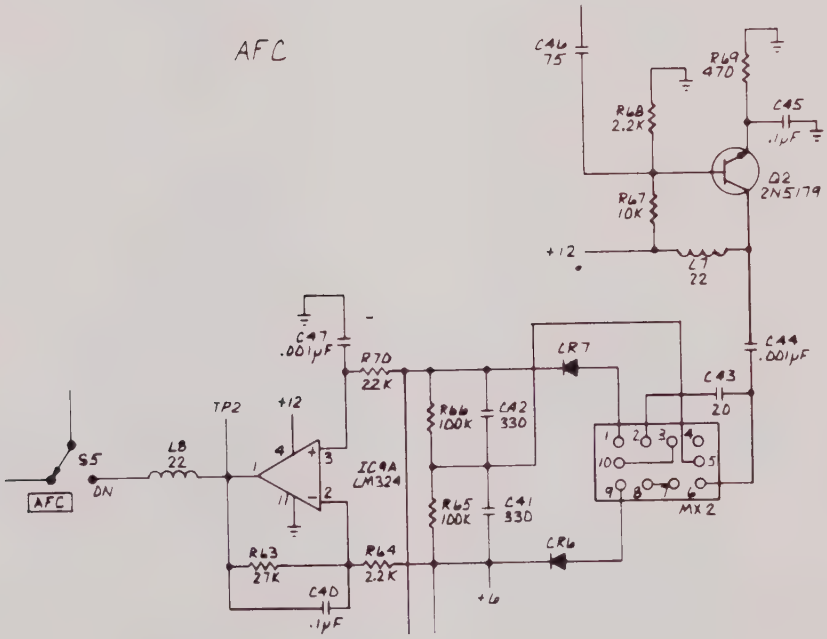
CHARGE CIRCUIT

The 110 VAC is applied through the front panel receptacle to transformer T2. T2 steps the voltage down to approximately 16 VAC. This voltage is then rectified by a full-wave bridge rectifier, CR-13. This voltage is filtered by C66 and applied to the battery by way of DS1 and DS2, which acts as a current limiter.



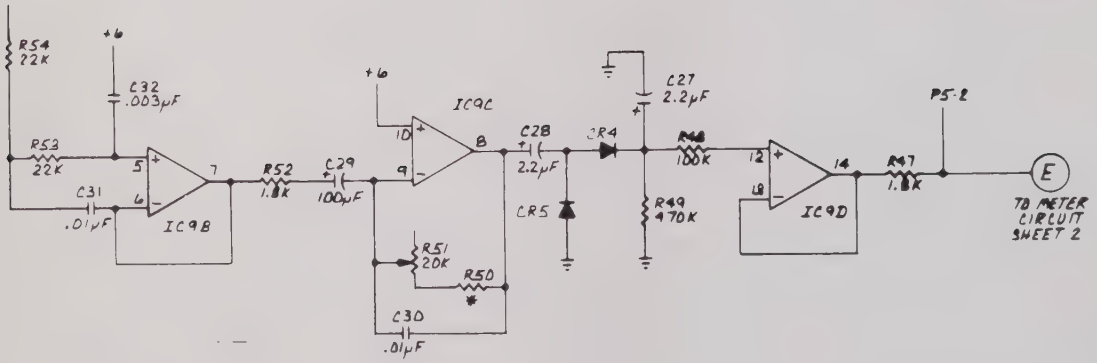
DISCRIMINATOR

The second output-pin of IC3 is a buffered output of the 10.7 MHz signal which is further amplified by Q2, which functions as a limiter. This amplified signal is then applied to the discriminator transformer (MX-2). The discriminator output as seen on pin 3 of IC9A will increase or decrease in voltage as the IF signal increases or decreases in frequency. This voltage is amplified by IC9A and the output pin 1, is applied to a varactor diode (BB105) in the 3rd L.O. (35.05 MHz). When the AFC switch is on, this voltage at the varactor will change. This changing voltage results in the 3rd L.O. increasing or decreasing in frequency, thus causing the mixed output to result in 10.7 MHz.



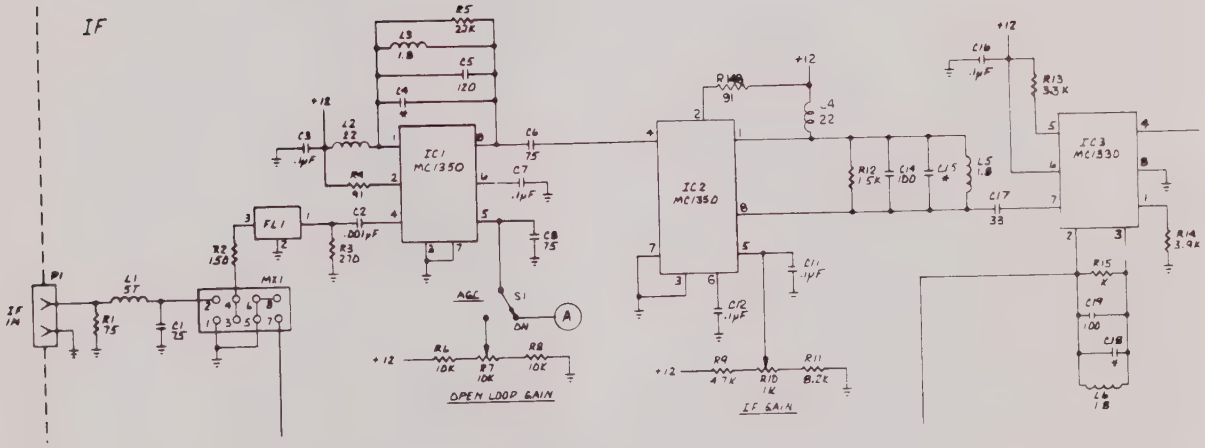
HUM

The hum circuit is designed to measure low frequency modulation. The peak detector circuit is disabled in the hum mode. It is disabled because you are not interested in reading a peak signal, but the amount of low frequency modulation on the carrier. The output of the video amplifier (IC4 pin 6) is applied to an active filter consisting of IC9B. This active filter is designed to pass frequencies up to 500 Hz. This 500 is to allow for an accurate measurement, if the hum is a square wave. Square waves contain frequencies much higher than the fundamentals. The 60 Hz signal if present is AC coupled to IC9C, which amplifies the signal. This signal from IC9C provides a 6V reference. The AC signal is applied to a voltage doubler (P-P detector), consisting of CR4, CR5, C27 and C28. The DC voltage is buffered by IC9D and applied to the meter movement through R47.



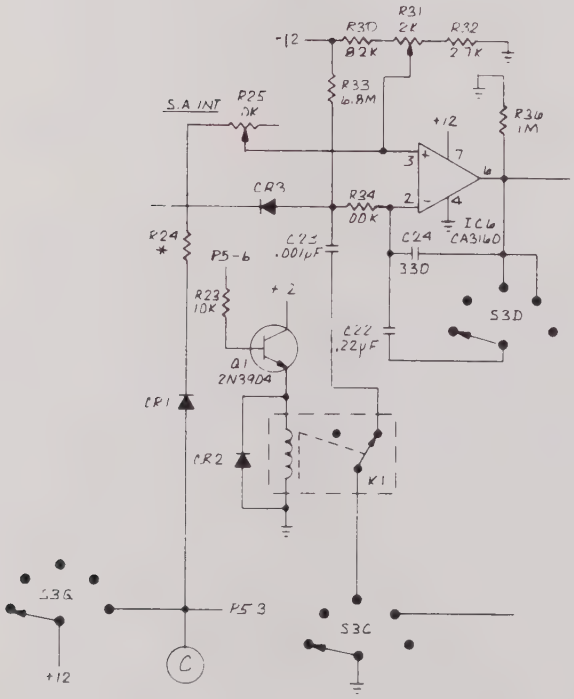
I.F.

The IF signal is applied at P1. The R1 is a 75 ohm termination. L1 and C1 provide for a low pass filter. The signal is then mixed with a 35.05 MHz signal in MX-1. The resultant output of 10.7 MHz is applied to a ceramic filter FL-1, which limits the bandwidth to approximately 280 kHz. The signal is then amplified by IC1 (1350), which is capable of 50 dB of gain. The IC1 has an AGC range of 60 dB. This circuit has to be tuned to 10.7 MHz in order to achieve the high gain. This tuning is accomplished by C4, C5 and L3. The R5 provides decueing to allow for correct bandwidth. This amplified signal is capacitively coupled to IC2, which provides an additional 20 dB of gain. This gain can be varied by R10. This may need to be changed to provide optimum meter tracking. This circuit also needs to be tuned to 10.7 MHz by C14, C15 an L5. The R12 provide decueing to allow for correct bandwidth. This amplified signal is applied to IC3, which provides additional gain and incorporates the video detector. This circuit is tuned to 10.7 MHz by C18, C19 and L6. The R15 provides decueing to allow for correct bandwidth. At TP-1 there isn't any RF present, however there is some modulation.



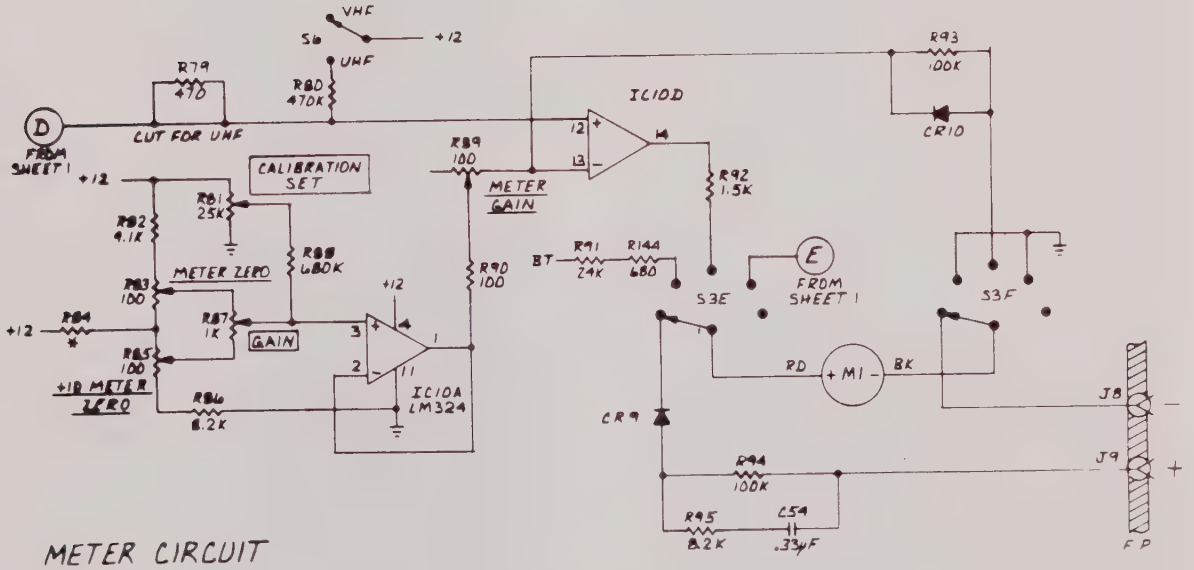
INTEGRATOR

The integrator is a comparator used to supply the AGC voltage. A reference voltage is set up on pin 3 of IC6, which is controlled by R31. When a strong IF signal is applied to the IF input, the voltage on pin 2 decreases. As this voltage decreases, the voltage on pin 6 increases. This signal is buffered by IC10C. The output at pin 8 is applied to pin 5 of IC1. This feedback will decrease the gain of the 1350. This AGC loop maintains a constant signal level through the IF. The purpose of C22 and C24 is to slow the comparator to prevent oscillations. When in the spectrum analyzer mode, 12V is applied to CR1 through R24 and R25. This changes the integrator reference voltage a very small amount. This integrator voltage changes the gain of the IF (since the integrator supplies the AGC voltage). The R25 adjusts this level for the best spectrum analyzer display.



METER CIRCUIT

The meter circuit is driven by the AGC voltage rather than the detected IF. The purpose of IC10A is to provide a reference voltage to be compared with the AGC voltage. The main reference is set up by R82, R83, R84, and R85. The R81 will provide a small amount of deviation to this main reference voltage. The R87 is used to increase this reference voltage a very small amount, to boost the meter reading by 10 dB for reading the low signal levels. IC10A is merely a buffer to provide isolation between the voltage divider and the meter amplifier. IC10D is a voltage to current converter. As the voltage increases on pin 10 above the voltage on pin 13, the voltage on pin 14 also increases. This voltage at pin 14 will cause current to flow through the meter and through CR10. The CR10 is forward biased and therefore allows the current to flow back through R92 to IC10D. Since the amount of gain is determined by the feedback resistance divided by the input resistance, the gain can be varied by the input resistance of R89. The R89 is used to calibrate the high end of the meter.

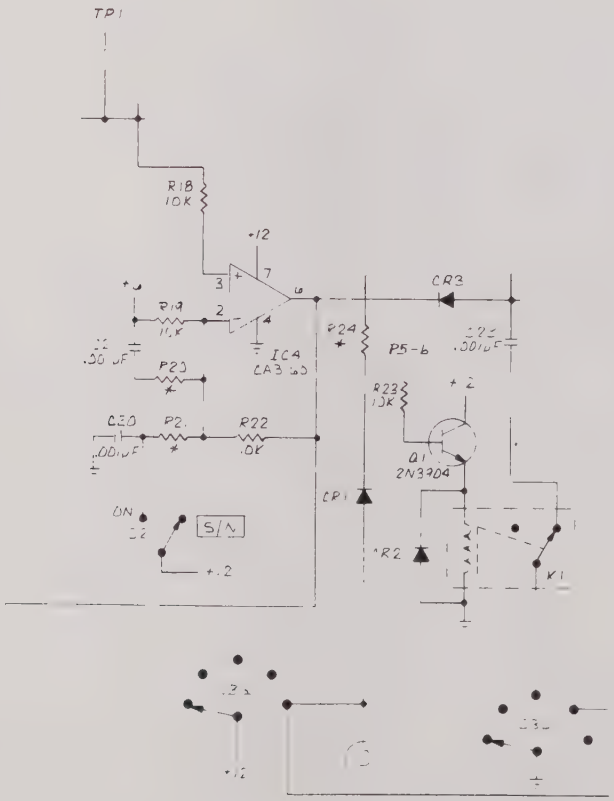


METER CIRCUIT

PEAK DETECTOR

The detected output from the IF is amplified by IC4 and is fed to a peak detector of CR3 and C23. The purpose of this detector circuit is to charge up C23 to the peak value of the modulation. All signal level meters measure peak value not average or RMS values. No detector is perfect and since C23 will discharge a certain amount, this voltage will still not be an absolute peak value. The purpose of C21 and R20 is to boost the gain of IC4 a small amount when video modulation is present. The C23 provides a ground path for the peak detector circuit.

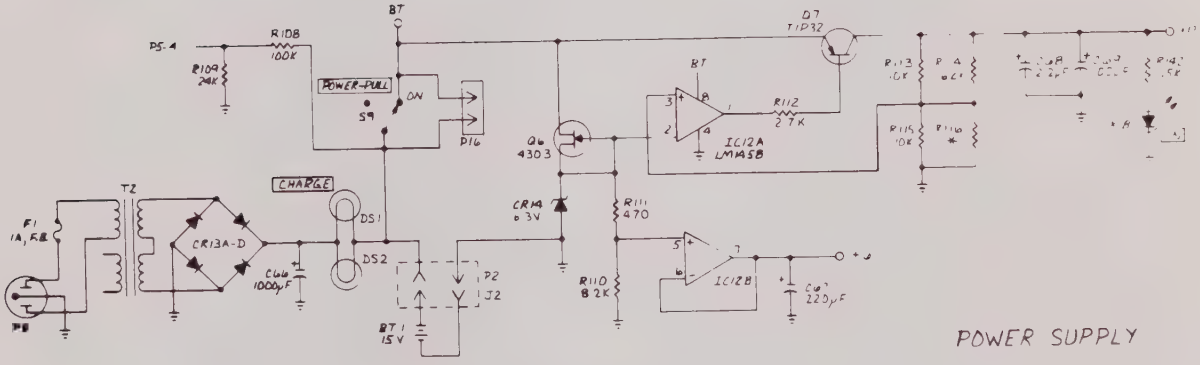
For Sam IIID's and Sam IV's, the peak detector circuit must be disabled in order to allow for an accurate hum measurement. The microprocessor board must have a means to switch this circuit out when making a remote hum measurement. This is accomplished by applying a high (5V) level from the microprocessor to R23, forward biasing Q1. The Q1 intergizes the coil relay of K1, thus opening the contacts of K1. This action effectively takes C23 out of the circuit.



POWER SUPPLY

Q6 supplies a constant current source for zener diode CR14. The CR14 provides a 6.2 V reference, which goes to a voltage divider of R110 and R111. This 6.2V reference is buffered by IC12B. The 6.2 V reference is applied to the inverting port of comparator IC12A. When power is first applied, the output on pin 1 of IC12A will be high, which causes Q7 to conduct very slightly. This allows only a small voltage to be seen on the output of the supply. The supply voltage is applied to a voltage divider of R113, R114, R115 and R116. The voltage divider cuts voltage approximately in half. This voltage is applied to the non-inverting port of IC12A. Since this voltage is lower than the voltage on pin2, the output on pin 1 will decrease, Q7 conducts harder, which supplies a higher supply voltage. The supply voltage is regulated by comparing the values of the two input voltages of IC12A. R116 is chosen to result in a 12V reference.

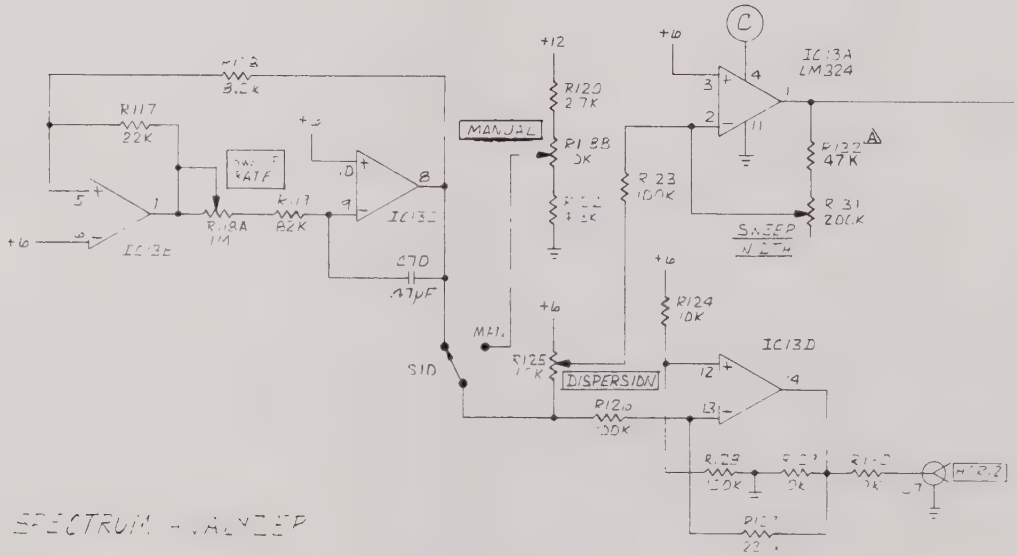
For Models Sam IIID's and Sam IV's, R108 and R109 provide a sample of the battery voltage for the microprocessor board to calibrate the actual battery voltage.



SPECTRUM ANALYZER

IC13B and IC13C form a ramp oscillator, whose frequency is varied by R118. This ramp voltage is applied to IC13D, where it is amplified to provide the horizontal drive required for the oscilloscope. The ramp output from IC13C is also applied to a separate amplifier of IC13A. The IC13A's output (an inverted ramp), is applied to the tuning circuit. The IC13A causes the 1st L.O. frequency to increase and decrease corresponding with the horizontal drive to the oscilloscope. The dispersion potentiometer (R125) is used to increase or decrease the amplitude of the ramp signal applied to the tuning section. This dispersion potentiometer allows for a small or large span of frequencies. The auto/manual switch (S5) allows the tuning voltage to be varied manually, by adjusting the manual sweep potentiometer (R118).

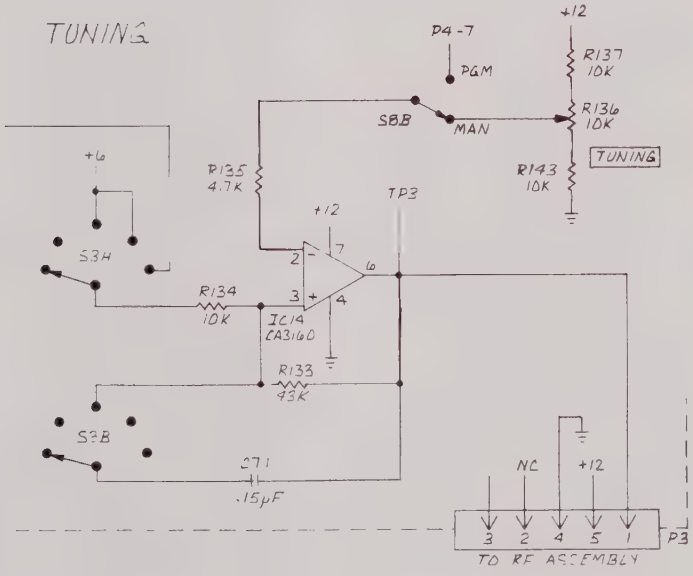
The varactor drive amplifier, IC14 is used as an inverting amplifier in the Sam III's and the Sam IV's. The horizontal drive ramp is also inverted, this will prevent the analyzer from being displayed backwards.



TUNING CIRCUIT

This circuit consists of a series of voltage divider networks, which can be switched between bands by S201. The two voltages, which are selected by S201 and applied to pin 5 of IC201A and pin 3 of IC201B, are buffered through the 1458 to provide isolation. These two outputs are then applied to R136 on the front panel. The wiper of R136 (course tuning potentiometer) will have a voltage corresponding to the band selected on the front panel. This voltage is amplified by IC14 and its output (pin 6) is then applied to RF assembly. R137 and the fine tuning potentiometer allow for a very small change in the output voltage.

The Sam III and Sam IV manual tuning is accomplished by applying a 4-8V signal from R136 to the varactor drive amplifier (IC14). IC14 is an inverting amplifier with an output voltage swing from 0-12V. C71 and C72 are used to prevent an audio frequency oscillation of (5 KHz). Program tuning is accomplished by switching the input to this amplifier (IC14) from R136 to the output of the microprocessor board, via S8B.

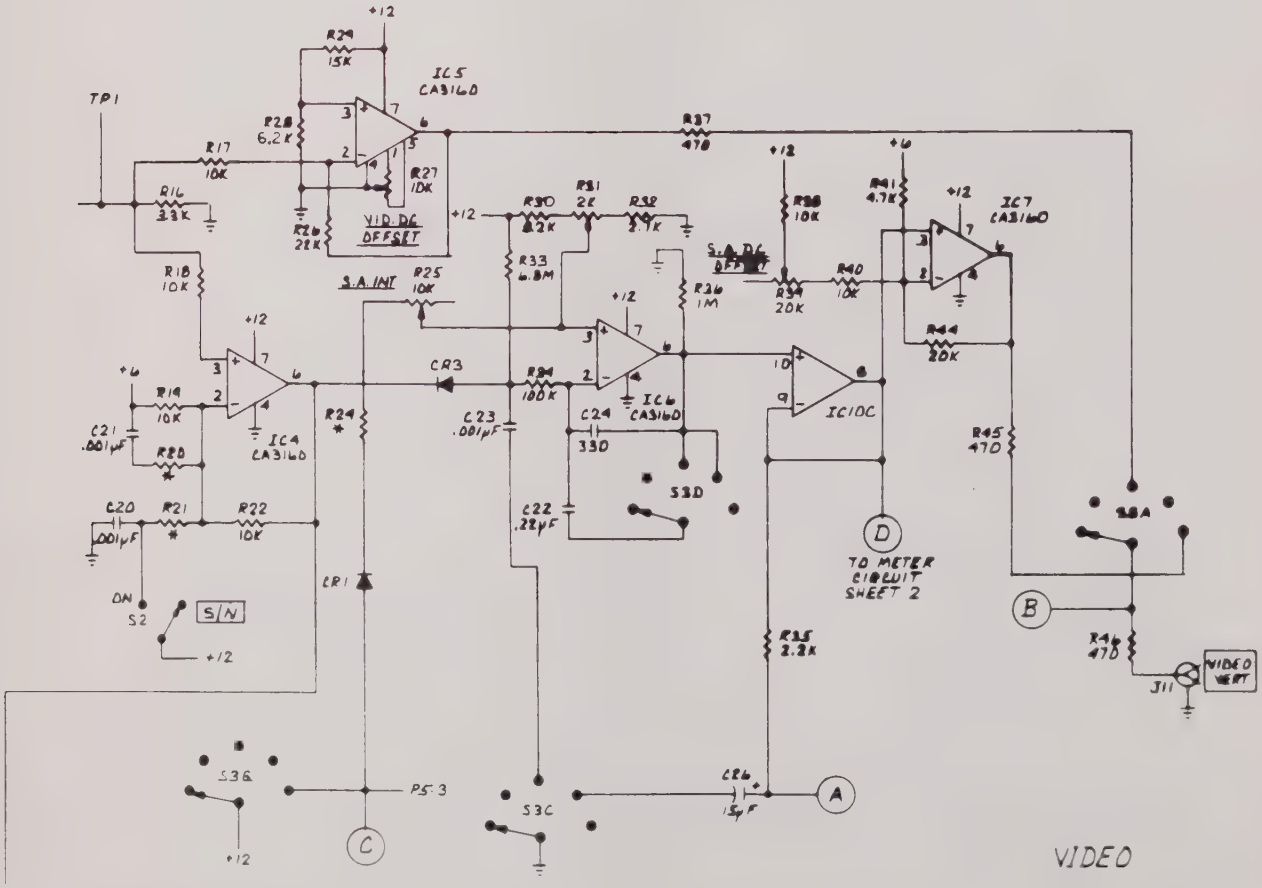


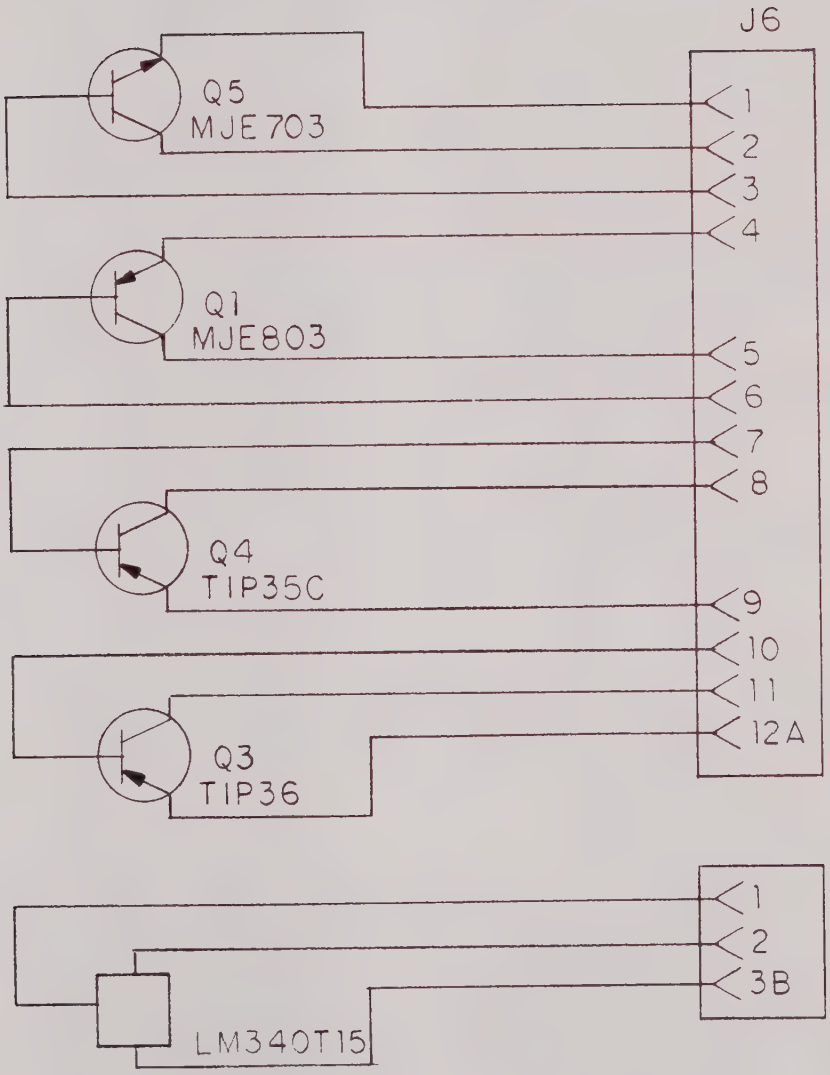
VERTICAL/VIDEO AMPS

The purpose is to provide a video output that can be monitored with an oscilloscope. The detected signal from IC3 pin 4 is amplified by IC5 and fed through S3A to the front panel F connector. The combination of R28 and R29 and the DC offset potentiometer (R27) is to provide an offset voltage of approximately .2V. The IC7 provides the vertical output for the oscilloscope in the spectrum analyzer mode. The IC7 amplifies the AGC voltage from IC10C, pin 8. The R38, R39, R40 and R41 provide an offset voltage to place the baseline of the noise level at OV.

R42 and R43 provide a sample voltage corresponding to the amplitude of the signal level. This voltage is applied to the microprocessor board. This voltage will determine the actual signal level and take a remote reading. The purpose of C25 is to filter out any spikes to prevent erroneous remote amplitude readings.

Since the normal DC offset R39 is used to adjust the remote signal level reading another means of adjusting the baseline of the noise level is required. This adjustment is accomplished by applying 12V to CR9 and R146. R146 is adjusted to provide the proper baseline.




J6
Q5
MJE703
Q1
MJE803
Q4
TIP35C
Q3
TIP36
LM340T15
1
2
3
4
5
6
7
8
9
10
11
12A
1
2
3B

SAM IV MAINBOARD PRELIMINARY CALIBRATION

I. Physical Inspection
   1) Examine unit for defects.

II. Voltmeter
   1) Place function switch to "volts" position.
   2) Connect a voltage source to the front panel voltmeter jacks and check meter reading. Accuracy must be ±5%.

III. Charge Circuit
   1) Plug A.C. charge cord into 110Vac and connect to the unit. Connect a dummy battery of 110Ω in place of a battery or power source.
   2) Turn the unit on and.the "ON" charge lamp on the main PCB should light. Turn unit off and the charge lamp should dim.

IV. Power Supply
   1) Connect battery cable to external power supply at 14V.
   2) Turn on power switch and check 6V supply for 5.58V to 6.1V.
   3) Connect voltmeter to 12V supply and select resistor value of R116 to read 12.0V to 12.1V.
   4) Place function switch in the "batt. ck" position and lower the voltage source to 12.5V The meter should read "recharge".
   5) Vary the voltage source from 12.5V to 16.0V. The supply should not change more than ±.005V.

V. Meter and Display Lights
   1) Turn on light switch, the two lamps in the meter should light.

VI. Varactor Drive
   1) Function switch needs to be in SLM mode.
   2) Connect a voltmeter to test point 3 (pin 6 of IC14). Turning the tuning potentiometer from one extreme to the other should produce a varactor drive voltage of 0 to 12V.(0=.05V maximum,12=11.8V minmum).

VII. Spectrum Analyzer
(Analyzer Units Only)
   1) Connect scope probe from demod input of an 1801 sweeper to horizontal output connector of the SAM.
   2) Set vertical sensitivity to 2V per division, and horizontal time base to 5ms.
   3) Place the function switch in Spectrum Analyzer mode.
   4) Place sweep rate/manual switch in the manual position. By varying manual control potentiometer, you should see a voltage go from 0 to 9V.
   5) Place sweep rate/manual switch in sweep rate position. By varying sweep rate control potentiometer, you should see a sawtooth waveform go from 0 to 9V with waveform varying from flat to full angle.

VIII. 3rd L.O.

1) Must bein open loop.
2) Place funtion switch in SLM position. Turn AFC on.
3) Connect a pick off loop to a frequency counter capable of reading 35.05 MHz.
4) Hold up the pick off loop near the 3rd L.O. tuning coil (T1), as far away as possible to maintain as accurate reading.
5) Using a tuning stick, adjust slug in coil (T1) for a frequency of 35.05 MHz. Turn off AFC and adjust R73 for 35.05 MHz.
6) Repeat step 5 above until AFC off and AFC on, both result in a frequency of 35.05 MHz ±.03 MHz.

IX. Sweep IF

1) Must be in open loop. (Open loop is achieved by placing slide switch S1 in its right side position.)
2) Using an IF cable, inject a signal at the IF input on the mainboard.
3) Adjust sweep to center frequency of 45.75 MHz, sweep width 1MHz at +20 dBmV and sweep rate = 100 msec.
4) Connect a scope probe to the video vertical connector on the Sam.
5) Set scope vertical position to .2 V per division.
6) Set the scopes horizontal input to .5 V per division and connect the scope to the horizontal output of the sweeper.

X. Video Offset

1) Must be in open loop.
2) Adjust R27 for a dc level of 1 V above ground.
3) Adjust R7 for an open loop gain for about a 1 V signal.

XI. AFC

1) Must be in open loop.
2) Connect scope probe to test point 2.
3) Set scope vertical to 1 V per division and adjust the pin slug of the discriminator for maximizum amplitude, and the blue slug for symetrical waveform. The signal should be at least 4 V peak to peak.

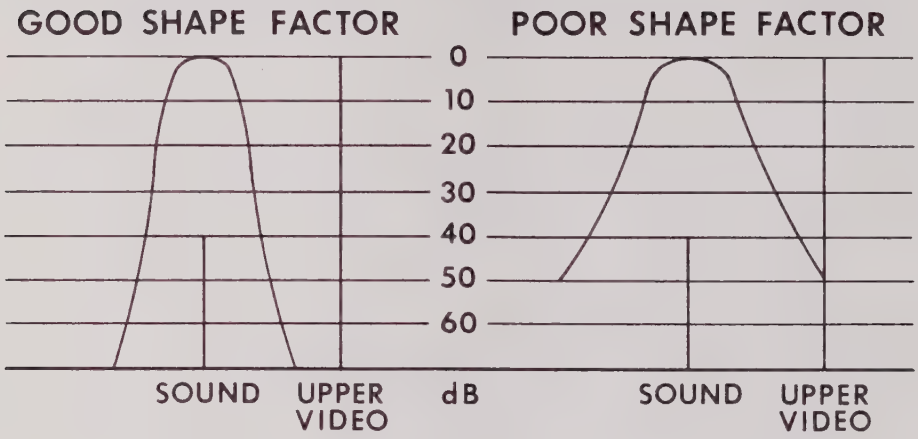
XII. Tune IF

1) Must be in open loop.
2) Re-connect the scope probe to the video vertical connector on the Sam.
3) Scope vertical sensitivity should be .2 V per division.
4) Using test probe, inject a signal at pin 1 of IC2 (1550).
5) Adjust sweep to 10.7 MHz center frequency, sweep width of about 1 MHz and amplitude to + 10 dBmV.
6) Select capacitance values across the 2nd and 3rd tank circuits in the IF, C15 and C18 until the response is centered a 10.7 MHz. Remove test probe.

XIII. Shaping Response

1) Must be in open loop
2) Using an IF cable, inject a signal at the IF input of the Sam.
3) Frequency should be at 45.75 MHz, sweep width = 1 MHz, at +20 dBmV.
4) If necessary, select a capacitor value C4 across the first IF tank circuit to acheive a flat or haystacked response, rather than a tilted, notched or pointed response. Solder capacitor in place.

REFER TO PICTURES BELOW FOR TYPICAL GOOD IF RESPONSE AND BAD IF RESPONSE



XIV. Open Loop Gain

1) Set scope vertical to 1 V per division and adjust the pink slug of the discriminator for maximizing amplitude, and the blue slug for a symetrical waveform. The signal should be at least 4V peak to peak.

XV. AFC

1) Must be in open loop.
2) Connect scope probe to test point 2.
3) Set scope vertical to 1 V per division and adjust the pink slug of the discriminator for maximizing amplitude, and the blue slug for symetrical waveform. The signal should be at least 4 V peak to peak.

XVI. Integrator

1) Must be in closed loop. (Slide switch S1 is in its left side position.)
2) Connect scope probe to test point 1, pin 4 of IC3 (1330).
3) Set scope vertical to .5 V per division, and adjust vertical position until an inverted response appears.
4) Close loop switch and place sweeper in manual sweep mode. Sweep through from no signal to a maximum signal. The maximum signal condition should lower the response by .4 V.
5) Adjust R31 for a .4 V difference.

XVII. Meter Tracking

1) Must be in closed loop.
2) Place function switch to the SLM mode, set potentiometers R81 (cal. set), R84 (10 dB gain), R87 (+10), R83 (-10) and IF gain to center of their positions.
3) Front panel +10 dB gain potentiometer should be in cal position.
4) Using an IF cable, inject a signal from an MC-50 or your meter calibrator,at 45.75 MHz and at +20 dBmV. Watch the meter, adjust frequency of MC-50 for maximum amplitude.
5) If necessary, select a resistor value R84 to achieve a mid scale reading.
6) Re-adjust frequency of MC-50 for a maximum meter reading and repeat step 5 above if necessary.
7) Reduce MC-50 amplitude by 10 dB and adjust R83 for a left scale reading. return amplitude to original +20 dB.
8) Increase amplitude by 10 dB and adjust R85 for a right scal reading. Return amplitude to original +20 dB.
9) Repeat step 7 above.
10) Reduce amplitude by 10 dB and turn front panel +10 dB gain potentiometer fully clockwise and adjust R89 for a mid scale reading. Return front panel +10 dB gain potentiometer to "cal" position. Reset R83 to read left scale.
11) Repeat steps 7 and 10 above.

XVIII. Peak Detector

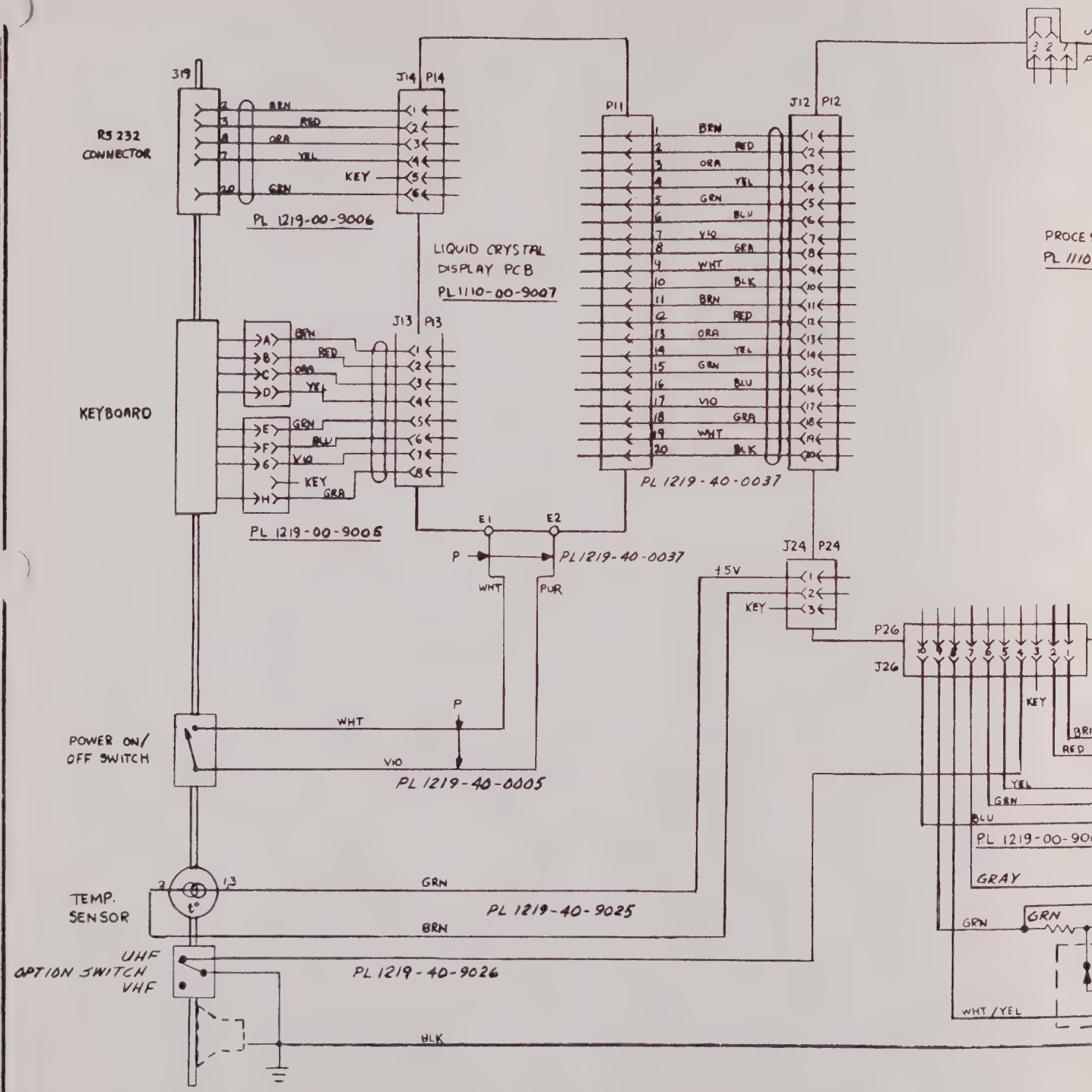
1) Connect an MC50 to the RF input os the Sam and peak on a signal. Press the modulation switch of the MC50, the needle of the meter should drop. Select a resistor and complete the circuit at position R20. Change the value of this resistor (27K ohm ±10K ohm) until a needle drop of no more than .2 dB is achieved.

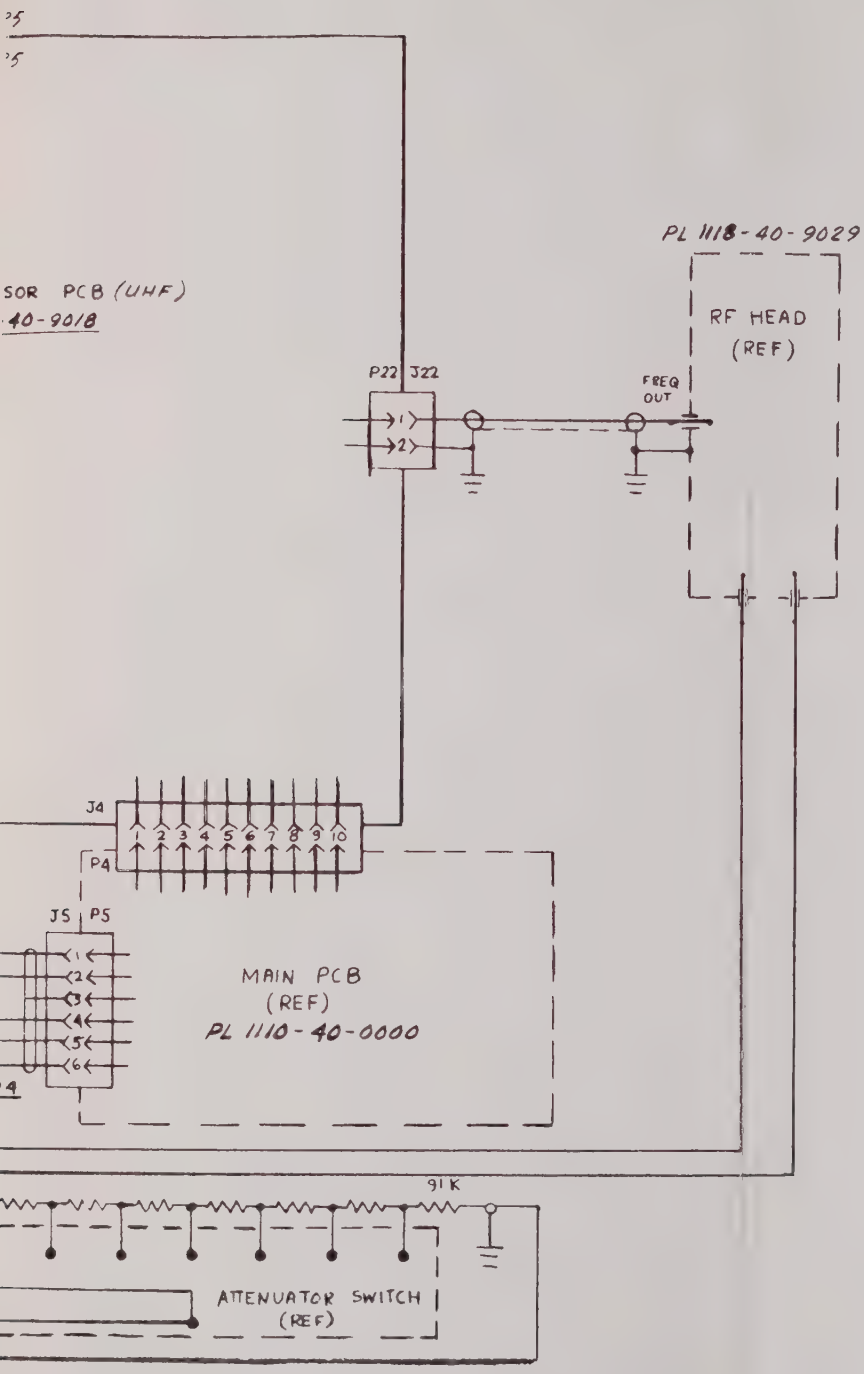
XIX. Hum

1) Use 27K ohm resistor to complete circuit position R50, check circuit.
2) Adjust R51 for mid scale, then switch a calibrated hum source MC-50 from 2% to 4% hum modulation.
3) Adjust hum R51 for 2% and 4% meter scale. If unable to center, raise or lower resistor.

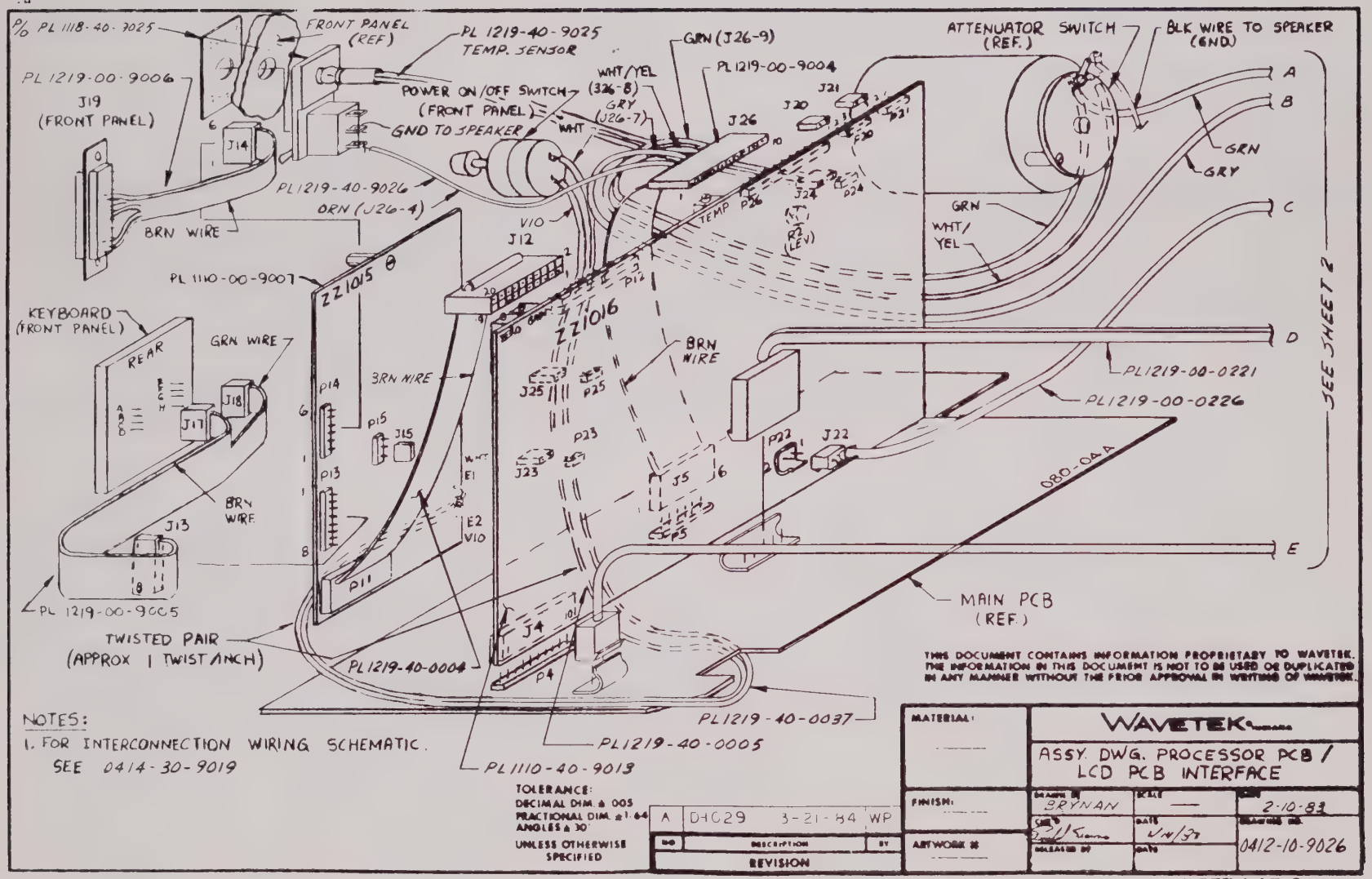
XX. Calibrator

1) Connect the calibrator output to a frequency counter capable of measuring 150 MHz.
2) Adjust the oscillator tuning slug, L11 for a frequency of 150 MHz and verify that the calibrator amplitude R102 does not alter the frequency more than 2 MHz.
3) Connect the calibrator output to a Sam and adjust the calibrator amplitude R102 to achieve +20 dBmV. Verify that the potentiometer still has ±2 dB of range, minimum.
4) Solder calibrator shielding can in place reset the frequency to 150 MHz ±.1 MHz.


J19
J14 P14
RS 232 CONNECTOR
BRN
RED
ORA
YEL
KEY
GRN
PL 1219-00-9006
LIQUID CRYSTAL DISPLAY PCB
PL 1110-00-9007
P11
J12 P12
PL 1219-40-0037
J13 P3
KEYBOARD
PL 1219-00-9005
E1
E2
P
PL 1219-40-0037
WHT
PUR
J24 P24
+5V
KEY
P26
J26
POWER ON/ OFF SWITCH
WHT
VIO
PL 1219-40-0005
TEMP. SENSOR
GRN
BRN
PL 1219-40-9025
UHF
OPTION SWITCH
VHF
PL 1219-40-9026
BLK
YEL
BLU
GRAY
WHT/YEL



	WAVETEK		
	Schematic Diagram Processor PCB/LCD PCB Interface		
1	Bill Sims	7 4/83	0414-30-9019


P/O PL 1118-40-9025
FRONT PANEL (REF)
PL 1219-40-9025 TEMP. SENSOR
GRN (J26-9)
ATTENUATOR SWITCH (REF.)
BLK WIRE TO SPEAKER (GND)
PL 1219-00-9006
J19 (FRONT PANEL)
POWER ON/OFF SWITCH (FRONT PANEL)
GND TO SPEAKER
WHT/YEL (J26-8)
GRY (J26-7)
WHT
PL 1219-00-9004
J26
J21
J20
J24
J14
PL1219-40-9026
ORN (J26-4)
BRN WIRE
VIO
J12
TEMP
PL 1110-00-9007
ZZ1015 θ
ZZ1016
KEYBOARD (FRONT PANEL)
REAR
GRN WIRE
BRN WIRE
J18
J17
P14
P15
J15
P13
J13
P11
E1
E2
VIO
J25
P25
P23
J23
J5
P5
P22
J22
080-04A
PL1219-00-0221
PL1219-00-0226
SEE SHEET 2
A
B
C
D
E
GRN
GRY
GRN
WHT/YEL
PL 1219-00-9005
TWISTED PAIR (APPROX 1 TWIST/INCH)
PL1219-40-0004
J4
P4
MAIN PCB (REF.)
PL1219-40-0037
PL1219-40-0005
PL1110-40-9013
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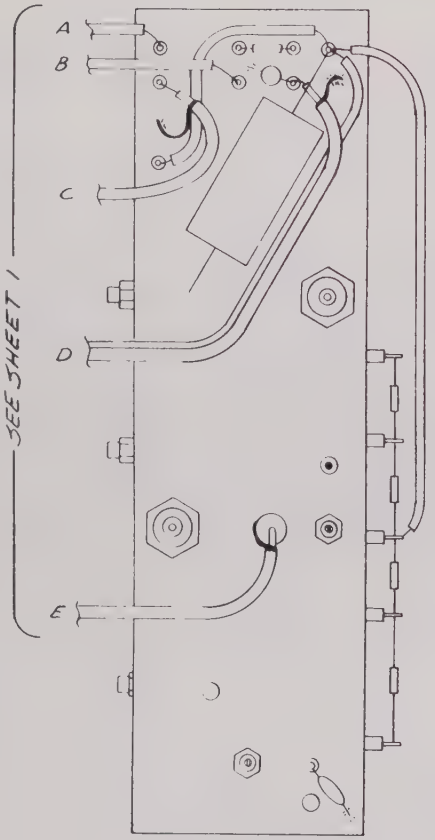
NOTES:
1. FOR INTERCONNECTION WIRING SCHEMATIC. SEE 0414-30-9019
TOLERANCE:
DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED
A DHC29 3-21-84 WP
REVISION
MATERIAL:
FINISH:
ARTWORK #
WAVETEK
ASSY. DWG. PROCESSOR PCB / LCD PCB INTERFACE
DRAWN BY BRYNAN
DATE 2-10-83
DRAWING NO. 0412-10-9026
SHEET 1 OF 2



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DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED

NO.	DESCRIPTION	BY
REVISION		

MATERIAL: ———

FINISH: ———

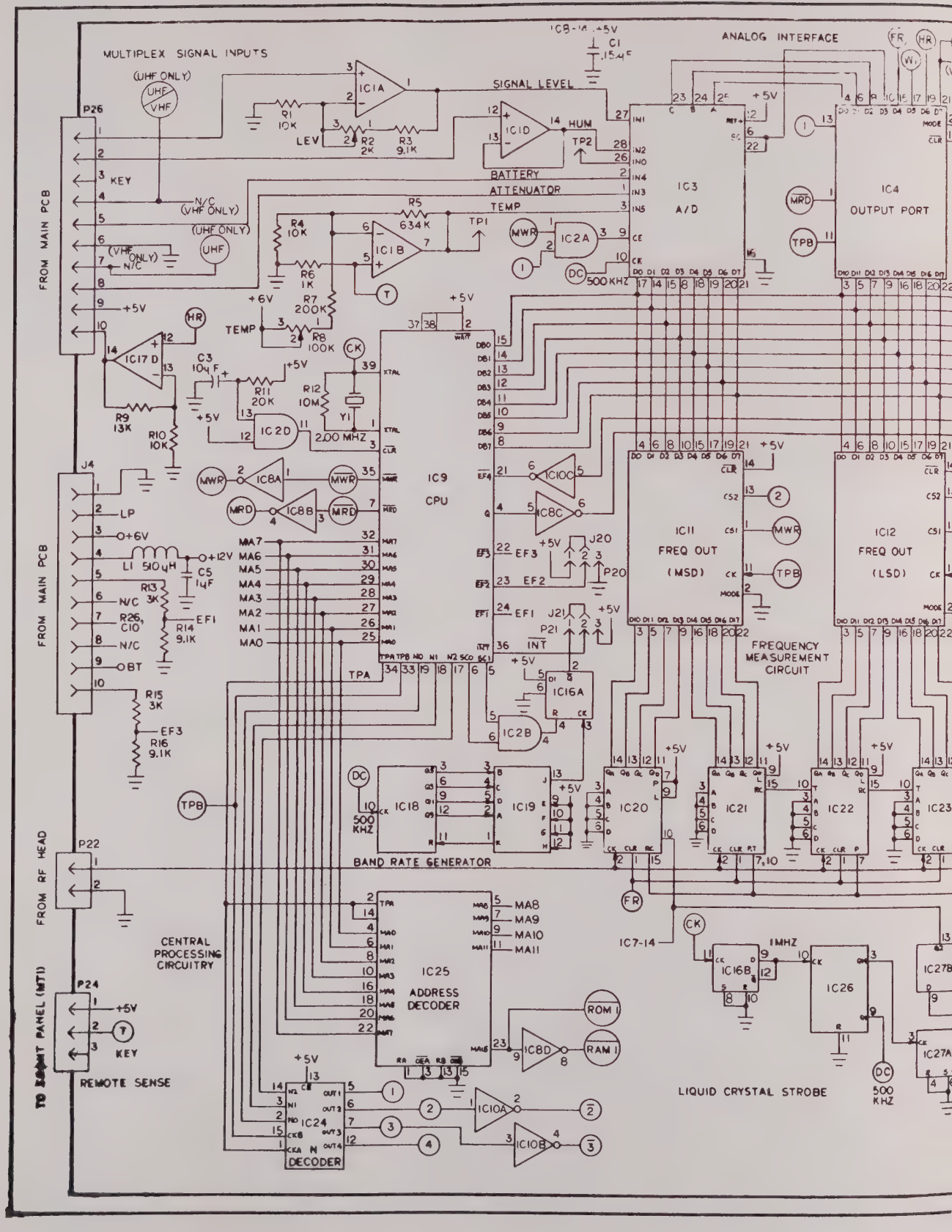
ARTWORK # ———

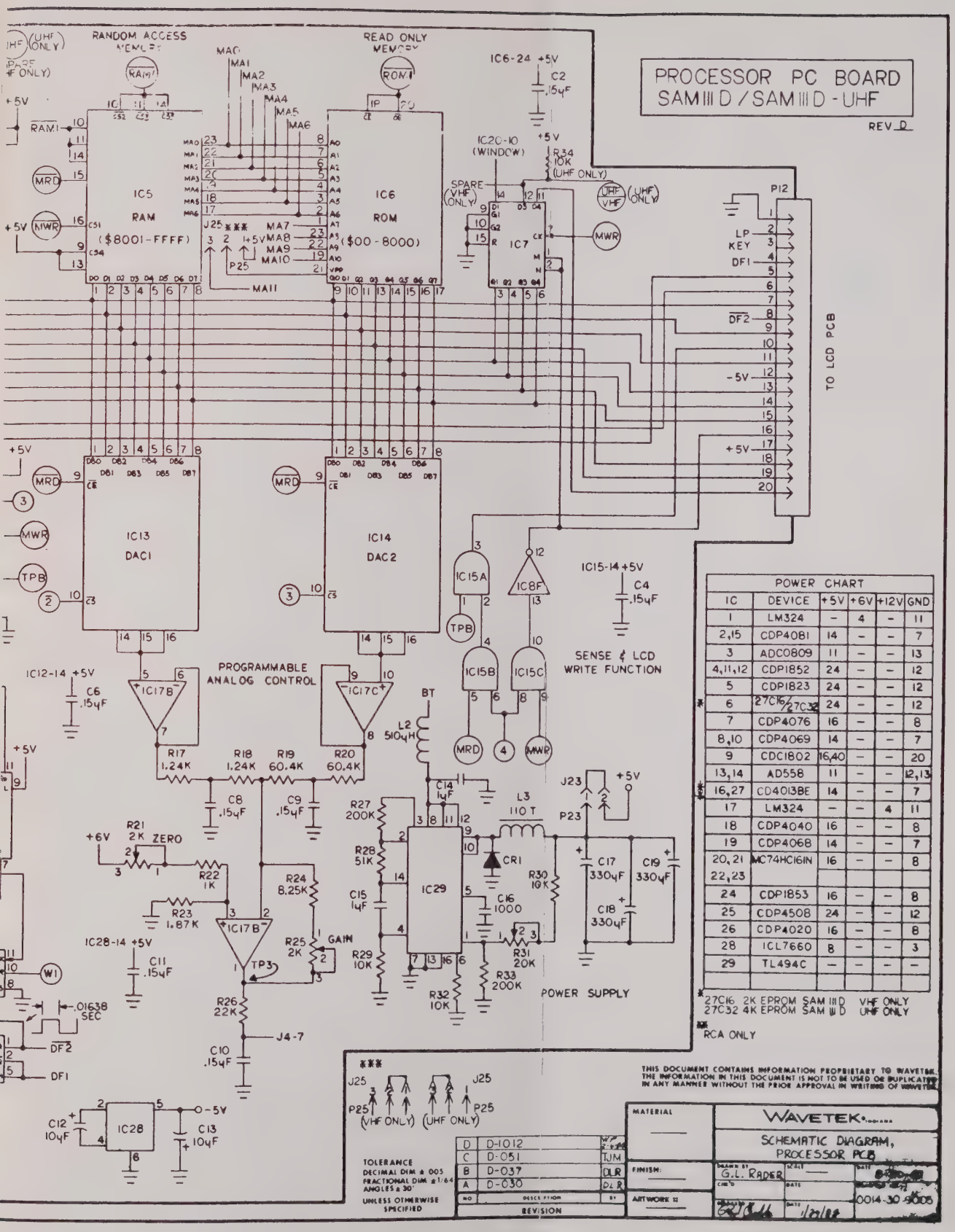
WAVETEK INDIANA

A33Y DWG, PROCESSOR PCB/ LCD PCB INTERFACE

DRAWN BY: BRYNAN	SCALE: ———	DATE: 2-10-83
CHK'D: [signature]	DATE: 2/14/83	DRAWING NO.: 0412-10-9026
RELEASED BY	DATE	

SHEET 2


MULTIPLEX SIGNAL INPUTS
ANALOG INTERFACE
FROM MAIN PCB
FROM MAIN PCB
FROM RF HEAD
TO FRONT PANEL (MTI)
P26
P22
P24
J4
(UHF ONLY)
UHF
VHF
KEY
N/C (VHF ONLY)
(UHF ONLY)
(VHF ONLY)
N/C
+5V
LP
O+6V
+12V
N/C
N/C
OBT
EF1
EF3
REMOTE SENSE
IC1A
IC1B
IC1C
IC1D
IC2A
IC2B
IC2C
IC2D
IC3
A/D
IC4
OUTPUT PORT
IC8A
IC8B
IC8C
IC8D
IC9
CPU
IC10A
IC10B
IC10C
IC11
FREQ OUT (MSD)
IC12
FREQ OUT (LSD)
FREQUENCY MEASUREMENT CIRCUIT
IC16A
IC16B
IC17 D
IC18
IC19
IC20
IC21
IC22
IC23
IC24
DECODER
IC25
ADDRESS DECODER
IC26
BAND RATE GENERATOR
CENTRAL PROCESSING CIRCUITRY
LIQUID CRYSTAL STROBE
SIGNAL LEVEL
HUM
BATTERY
ATTENUATOR
TEMP
LEV
R1 10K
R2 2K
R3 9.1K
R4 10K
R5 634K
R6 1K
R7 200K
R8 100K
R9 13K
R10 10K
R11 20K
R12 10M
R13 3K
R14 9.1K
R15 3K
R16 9.1K
C1 .15μF
C3 10μF
C5 1μF
L1 540μH
Y1 2.00 MHZ
500 KHZ
1MHZ
TP1
TP2
J20
J21
P20
P21
MA0
MA1
MA2
MA3
MA4
MA5
MA6
MA7
MA8
MA9
MA10
MA11
ROM 1
RAM 1
INT
WAIT
XTAL
MWR
MRD
TPA
TPB
CK
DC
FR
HR
W1
T



POWER CHART					
IC	DEVICE	+5V	+6V	+12V	GND
1	LM324	–	4	–	11
2,15	CDP4081	14	–	–	7
3	ADC0809	11	–	–	13
4,11,12	CDP1852	24	–	–	12
5	CDP1823	24	–	–	12
6	27C16/27C32	24	–	–	12
7	CDP4076	16	–	–	8
8,10	CDP4069	14	–	–	7
9	CDC1802	16,40	–	–	20
13,14	AD558	11	–	–	12,13
16,27	CD4013BE	14	–	–	7
17	LM324	–	–	4	11
18	CDP4040	16	–	–	8
19	CDP4068	14	–	–	7
20,21 22,23	MC74HC16IN	16	–	–	8
24	CDP1853	16	–	–	8
25	CDP4508	24	–	–	12
26	CDP4020	16	–	–	8
28	ICL7660	8	–	–	3
29	TL494C	–	–	–	–

* 27C16 2K EPROM SAM III D VHF ONLY
27C32 4K EPROM SAM III D UHF ONLY

** RCA ONLY

*** J25 P25 (VHF ONLY) (UHF ONLY) J25 P25

REVISION		
NO	DESCRIPTION	BY
D	D-1012	TJM
C	D-051	TJM
B	D-037	DLR
A	D-030	DLR

TOLERANCE
DECIMAL DIM ± .005
FRACTIONAL DIM ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED

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MATERIAL
FINISH:
ARTWORK #:

WAVETEK
SCHEMATIC DIAGRAM, PROCESSOR PCB
DRAWN BY G.L. RADER
DATE 1/21/88
0014-30-5005

MICROPROCESSOR BOARD THEORY OF OPERATION

1. SCOPE
This specification consists of the requirements and design characteristics of the Processor Board (PB) which is used on the Sam IIID and Sam IV systems.

2. SCHEMATIC
The schematic diagram for this board is drawing number 0014-30-9005 (D1390-05).

3 FUNCTION DESCRIPTION
This board contains (11) separate circuits: Central Processing Unit and Decoder (CPU/D), Read Only Memory (ROM), Random Access Memory (RAM), Frequency Measurement (FM), Programmable Analog Control (PAC), Analog Input (AI), Multiplex Signal Input, (MSI), Sense and Liquid Crystal Write Function (S/LCD), Band Rate Generator (BRG), Diagnostic Testing (DT), and Power Supply (PS).

3.1 CENTRAL PROCESSING UNIT AND DECODING (CPU/D)
The CPU/D consists of the microprocessor along with the associated hardware required to provide the address and 'N' line decoding. It is assumed the one has reviewed the "User Manual for the CDP1802 Cosmac Microprocessor" #MPM-201B prior to reviewing this specification. All error flags are used as inputs and the Q is utilized as an output. All transactions are handled by the CPU/D circuit.

3.2 READ ONY MEMORY (ROM)
The ROM contains all of the instructions which are necessary to perform the various tasks of the Sam IIID and Sam IV. The total capacity is 256 x 8 instructions.

3.3 RANDOM ACCESS MEMORY (RAM)
The RAM is used to provide temporary storage of information while performing the various tasks of the IIID and SAM IV. The total capacity is 128 x 8.

3.4 FREQUENCY MEASUREMENT (FM)
The FM Circuit is used to measure the frequency of the Sam IIID and Sam IV which provides an output to the Liquid Crystal Display (LCD).

3.5 PROGRAMMABLE ANALOG CONTROL (PAC)
The PAC circuit is used to provide a means for the microprocessor to control the frequency of the IIID and Sam IV by providing an analog voltage via processor control.

3.6 ANALOG INPUT (AI)
The AI Circuit provides a means to sense external analog inputs and interface them to the processor for interrogations.

3.7 MULTIPLEX SIGNAL INPUTS (MSI)
The MSI consists of (7) individual inputs which must be monitored and selected when the processor requests the input.

3.8 SENSE AND LIQUID CRYSTAL WRITE FUNCTION (S/LCD)

The S/LCD circuit provides the processor with vital information of various parameters in the Sam IIID and Sam IV. The LCD circuit interfaces the processor to the Liquid crystal Display in order to indicate an ouput response for the Sam IIID and Sam IV.

3.9 BAUD RATE GENERATOR (BRG)

The BRG is used to provide an interface to interrupt the normal activities of the processor and address another activity, in this case the activity is RS232 service.

3.10 DIAGNOSTIC TESTING (DT)

The DT Function is used to provide a means for the operator to test the Sam IIID and Sam IV without removing the board at a system level.

3.11 THE POWER SUPPLY

The power supply is used to provide a high efficiency regulator in order to increase the operating time when using a battery. The power supply consists of two parts (1) + 5 Volt and (2) - 5 Volts (RS232 only).

4. CIRCUIT DESCRITION

4.1 CENTRAL PROCESSING UNIT AND DECODING (CPU/D)

The CPU/D requires a master clock which consists of 2 MHz Crystal (YI) and Resistor. In order to insure that the processor begins at address $ 000 a delay circuit is used which consists of IC2D, C3 and R11. The C3 and R11 provide a delay of 200 Msec. When power is applied, C3 looks like a short circuit and causes Pin 11 to be at a zero state. C3 continues to charge to its maximum supply voltage (+5) then IC2D goes to a logic 1 state. Terminal assignments for the 1802 microprocessor (figure 1) a provided for reference only. Pins 35 and 7 on IC9 (microprocessor) provide the Memory Write and Memory Read signals which are used for added decoding. Pins 25 through 32 on IC9 provide the memory address which in turn goes to IC25 for decoding and latching of the high byte of the instruction cycle when TPA (Pin 31) occurs. IC25 provides a method to increment memory in two basic chunks, and provides a Chip Select (CS) for the RAM and ROM which is used in the Sam IIID and Sam IV. Pins 17 through 19 are the 'N' lines which go to IC24 for particular decoding when an output or input instruction is desired by the CPU. The balloons at the output of IC24, pins 5,6,7 and 12 refer to the software instructions labels such as Output 1 or Input 2. The data bus consists of Pins 8 through 15 on IC9. The Error flags are used to provide direct inputs to the processor. EF1 is used to detect the mode for the PIX/SND Switch. EF3 is used to detect the Program/Manual Mode. EF4 and the Q output are used to handle the RS232 interface. SC0, SC1 and INT are used in conjuction with the EF4 and Q combination concerning the RS232 interface.

4.2 READ ONLY MEMORY (ROM)

The ROM (IC6) consists of 256 word x 8 bit on 2048 memory locations of Read Only Memory. The entire program is located in this ROM including the diagnostic package. ROM1 on IC6, Pins 18 and 20 provide a means to select this chip. ROM occupies the space from $000 to $8000. Expansion to 4096 memory locations is provided if desired.

4.3 RANDOM ACCESS MEMORY (RAM)

The RAM (IC5) consists of 128 word x 8 bit static memory locations. RAM on IC5 pins 10,11, and 14 provide a means to select this chip. The RAM occupies the space from $8001 to $FFFF.

4.4 FREQUENCY MEASUREMENT (FM)

The FM circuit consists of IC 20,21,22,23,11,12 and IC27B. IC20 through IC23 are synchronous programmable 4 bit binary counters. The 'Window Concept' is employed. The frequency to be measured is inputed on Pin 2 of IC20 through 23. A digital controlled pulse (Window) is provided at the 'TE' input of IC20 , Pin 10. The window is exactly 16.8 Msec. Assume a frequency (FS) of 2.00 MHz as an input to IC20, Pin 2. The period P = 1/F = .5 x 10 -6 sec and the TE input will be high for a period of 16.8 Msec. The total count (Tc) will be equal to the TE input divided by the period of the Frequency (FS) input.

Therefore:

$$Tc = \frac{TE}{P} = \frac{16.8 \text{ Msec}}{.5 \times 10^{-6} \text{ sec}} = 3.36 \times 10^4 \text{ counts } (\$8340)$$

This is the count which will be stored in the four counters. The count is directly connected to IC11 and IC12 which are 8 bit Parallel Output Tri-State Ports. IC11 contains the MSD ($83) and IC12 contains the LSD ($40). The processor will activate a 'Input 2' (IC11-13) and 'Input 3' (IC12-13) in order to transfer the data from IC20 throught 23 to the Data Bus. It should be noted that IC27B insures that syncronization will be provided between the Processor, Window and Input Frequency. IC27B-9 is the 'Data' Input and IC27B-11 is the 'Clock' Input. Pin 10 on IC27B is the 'Window Inhibit' (WI) which is used to 'halt' the measurement of frequency. The processor monitors the window and knows when a measurement is in process. Once the measurement is completed, and the numbers are transferred, the processor will reset the counters to zero via the Frequency Reset (FR) on Pin 1 of IC20 throught 23.

4.5 PROGRAMMABLE ANALOG CONTROL (PAC)

The PAC consists of IC13, 14 and 17. IC13 and 14 is a complete voltage-output 8 Bit digital-to-analog converter, including output amplifier, full microprocessor interface and precision voltage reference. Pin 10 on IC13 and IC14 is the chip select to transfer data from the processor to IC17B and IC17C. IC17B and C are voltage followers. IC13 is the 'Course' adjust DAC which has a label of 'DAC1' and IC14 is the 'Fine' adjust DAC which is labeled as 'DAC2'. Since the output voltage at J4-7 is a function of frequency it is very important to have the maximum amount of control of the DC voltage. DAC1 and DAC2 both provide an output of 10 mV/bit resolution. The maximum output per DAC is $FF (255) Bits x 10 mV/bit=2.55 Volts. The 17, C8 and R18 is a filter as well as an attenuator for DAC1. The R24 and R25 provide feed back for the amplifier IC17B. R21, R22 and R23 provide the offset for IC17B. Assuming a typical gain of IC17B of 1.55. The R14 will provide a typical output offset of 6 Volts. This offset is required in order to interface to the main driver amplifier which is located on the main mother board. Again assuming a typical gain of 1.55, DAC1 will have a transfer function of 15.5 mV/bit. The filter and attenuator for DAC 2 consists of R20, C9 and R19. Assuming the same gain, DAC 2 will have a transfer function of 0.320 mV/bit. R26 and C10 provide additional de-coupling for the voltage prior to the main driver.

4.6 ANALOG INPUT (AI)

The AI input consists of IC3 and IC4. IC3 is a monolithic CMOS device with an 8 Bit analog-to-digital converter, 8 channel multiplexer and microprocessor compatible control logic. IC4 is a prallel 8 Bit mode programmable COS/MOS, input/output port which is configured as an output port. The selection of the analog input is determined by the 'N' line selection of IC3, pins 23,24, and 25. DO through D2 (IC4) are reserved for this selection via the microprocessor when an 'output 1' is performed. D3 and D5 are used for the Frequency Measurement Function and D6 is used for the Hum Select function. D7 is not used at this time. IC3 Pin 9 is the Chip Enable and is selected via an 'Input 1' instruction. Conversion occurs at a rate determined by the clock at IC3 Pin 10 which is 500 KHz.

4.7 MULTIPLEX SIGNAL INPUTS (MSI)

The MSI consists of IC1A,B and D. IC3 has a maximum capacity of 8 inputs, only 5 are utilized for the Sam IIID and Sam IV. A particular input channel is selected by using the address decoder. Table 1 shows the input states needed for the address lines to select any channel in IC3. Input number one (IN1) is used for Signal Level. The detected signal level enters the processor board via P26-1. IC1A is a Gain/Slope Amplifier with R1,R2 and R3. IN2 is used for Hum Level. The detected level enters the processor board via P26-2. IC1D is voltage follower configuration providing buffering for IC3. IN3 is the attenuator setting and IN4 is the battery status. The temperature level is IN5, and consist of IC1B and remote temperature Sensor, T. T provides a constant current source to the 1K (R6) resistor which goes to the non-inverting input of IC1B. Gain is provided by R5 and R4 and offset calibration is provided by R7 and potentiometer R8. Transfer functions and normalization curves will be found under circuit specifications.

4.8 SENSE AND LIQUID CRYSTAL WRITE FUNCTION (S/LCD)

The S/LCD consists of IC7 and IC15. IC7 is used as a sensing element in order to determine the status of two functions (1) Window and (2) Keyboard Data. The Window Function is generated at the Baud Rate Timing Circuit. The processor circuit senses the Window time in order to make the frequency measurement calculation. The keyboard data signal is used to tell the processor that a key has been depressed and a service request is desired. The LCD Write Function consists of IC15B, C and A along with IC8F. When an "Output 4" occurs, it is necessary to determine if thed processor should Read or Write from the I/O Ports. If the instruction is an " Input 4," then a Memory Read (MRD) will take place which means Data will be read from Memory and deposited to the Liquid Crystal Display Output Digits. If the instruction is an "Input 4" then a Memory Write Signal will cause IC7 (4 Bits) and Keyboard (4 Bits) to be read by the Processor.

4.9 BAUD RATE GENERATOR (BRG)

The BRG consists of IC16B (Divide by two), IC27 and 28 (Window Timing Circuit), IC18 and 19 (Baud Rate Timing Circuit), IC2B, 16A (Syncronization for Processor and Baud Rate Timing). IC16B receives the Clock Signal from the crystal and divides the Frequency by two. IC26 is a Binary Counter with a maximum count of 16384. Each Clock Input is 1 usec leading to a count of 16384 usec or 16.384 Msec. Since this is the maximum capacity of the Counter IC26, no reset is required to zero the Counter.

This provides the standard reference timing for the Frequency Window. IC27A provides a symetrical Output at this specified timing slot. This Window serves two purposes. (1) a Window for frequency measurement and (2) Display Frequency (DF) for the Liquid Crystal Display Board. IC26 also provides an additional output every 2 usec or 500 KHz. This is used to provide a clock for the A/D Converter along with a Clock for the Baud Rate Generator Circuit.

The Baud Rate Generator Circuit consists of IC18 and 19. This circuit is configured in such a manner as to provide an output at a rate of 1.8 kHz at Pin 13 of IC19. This signal is fed to (IC16A-3) the Clock Input and awaits the confirmation 'Data IN' pulse from IC2B-4 to syncronize the Processor to the Baud Rate Generator. This final Output Signal is connected to the INT Signal of the Processor in order to provide a Clock for the RS232 interface. J21 provides a means to disable the INT Signal if desired.

4.10 DIAGNOSTIC TESTING (DT)

The DT function is activated when J20 Jumper is connected between Pins 2 and 3. The processor senses EF2 and if EF2 should go low, it jumps to the diagnostic sub-routines. A particular sub-routine is selected by the position of EF1 (PIX/SND Switch) and EF3 (PIX/MAN Switch) as shown in Table 2. Figure 3 shows the keyboard configuration which is used on the Sam IID and Sam IV. It should be noted that the keyboard information required only (4) four bits of an (8) eight bit word. The least (4) four bits were chosen for keyboard information and the remaining upper four (4) bits for additional functions. The lower left side of each key indicates the HEX code required of the last (4) four bits in order to determine key identification for software. The dollars sign ($) signifies the HEX notaion.

4.11 POWER SUPPLY (PS)

There are two power supplies used on the Processor Board consisting of +5 Volt and -5 Volts.

4.11.1 +5 Volt Switcher Supply

The +5 Volt switcher supply consists of IC29 along with its associated parts. IC29 receives its power from the battery (BT) via an inductor and capacitor. This LC network provides decoupling for IC29 by providing a high impedance out to the lines going to the battery. R31 is used to adjust the 5 Volt Output under load. L3 and C17 through C19 provide the filter which is necessary for the +5 Volt Output. A jumper plug is provided (J23) in order to be able to check the 5 Volt Switching Power Supply under load prior to connecting the Processor circuitry.

4.11.2 -5 Volt Supply

The -5 Volt Supply IC28 is used on the Liquid Crystal Display Board for the RS232 interface. The Supply Output is dependent on the supply input because it inverts the positive voltage input. C12 and C13 are used to provide added decoupling for IC28.

5. CIRCUIT SPECIFICATIONS
Power Supply Voltage to be adjusted as per specification for Sam IIID and Sam IV.

SAM IV PROCESSOR BOARD AND LCD BOARD TEST AT SYSTEM LEVEL

NOTE: THE SAM SHOULD BE ON FOR AT LEAST 15 MINUTES PRIOR TO MAKING ANY ADJUSTMENTS.

Set up front panel as follows:

Power	off
Function	SLM
Gain	Cal.
PGM/MAN	MAN
AFC	off
PIX/SND	SND
Light	off
Attenuator	+15 - +25 scale

I DIAGNOSTIC TEST

1.a Turn power on. With DVM measure the voltage at P26-9, this should be +5.00VDC. If not, adjust R31 on the processor for +5VDC ±0.

1.b The liquid crystal display (LCD) will be sequencing alphanumerics from right (LSD) to left (MSD) as follows: 0,1,2,3,4,5,6,7,8,9,L,H,P,A,-, blank. The decimal point will beon at all times throughout test.

2 Place PGM/MAN switch to PGM. The display will blank except for the decimal. Depress the following keys on the keyboard and observe for proper display. The 2nd digit from the right will be the only digit displayed when the keys are depressed.

KEY	LCD DISPLAY	KEY	LCD DISPLAY
1	1.	9	9.
2	2.	Freq.	L.
3	3.	CHN	H.
4	4.	CHN (HRC	P.
5	5.	Next	A.
6	6.	·	-.
7	7.	CLR	·
8	8.	0	0.
9	9.		

3 Place PIX/SND switch to PIX position. Depress key 1. A four digit number will display. Adjust R21 on the processor board for an LCD display of 455.

4 Depress key 2. Adjust R25 on the processor board for a display of 000.0 and observe the signal on an 1801 or equivalent sweep generator and oscilloscope connected to video output. The 1801 should be set up for a 50 MMHz sweep width and the frequency should be set so you can observe 0 MHz to +50 MHz at +20 dBmV on the scope. Adjust R25 so the signal goes through 0 MHz and keep adjusting until the signal reaches -30 MHz. The LCD will still display 000.0..

5.a Place the PGM/MAN switch to manual. Using an MC-50, connect the RF output of the generator to RF input of the Sam IIID. Adjust the MC50 for 150 MHz at +20 dBmV. Slowly tune meter until the meter peaks. LCD should display 127.0 ±. If not adjust R39 on the Sam IIID mainboard.

5.b Set generator to +10 dBmV. The LCD should display 094.0 ±1, if not adjust R2 on the processor board.

5.c Set generator to +30 dBmV. LCD should display 160.0 ±1, if not repeat steps 5a and 5d until proper readings are obtained.

II MANUAL OPERATION

1. Turn off power and move P20 jumper from pins 1-2 to 2-3.
2. Turn on power. Rotate tuning knob to both extremes. At maximum counterclockwise position, LCD will display 0.0 and at maximum clockwise position LCD will display greater than or equal to 460.0 MHz.
3. Set attenuator to +15 - +25 range. With the MC-50 connected to RF in on the Sam III at 150 MHz and +20 dBmV, slowly tune frequency until meter peaks. Meter shall read +20 dBmV, if not adjust calibration set potentiometer on front panel for +20 dBmV on meter.
4. Connect a short cable from the cal. out on the Sam III front panel to RF in on the Sam III front panel and peak the meter. The meter should peak at +20 dBmV and the LCD will display 150.0 ±.1.
5. Tune the Sam to a known audio source and connect antenna or cable to the Sam. The audio should be relatively noise free, with no distortion.

III TRACKING ACCURACY

Place the Sam PGM/MAN switch to PGM. Depress 150.0 frequency on the keyboard. Set the attenuator at +15 - +25 scale. Connect MC-50 to the RF input on the Sam at 150.0 MHz and at +20 dBmV. With AFC off the signal should be at +20 dBmV on the Sam, if not adjust T1 on the mainboard until the meter peaks. With AFC on the needle should not move at all, if you try to repeak the Sam using the fine tune adjust on the MC-50 the frequency should not move more than ±.03 MHz. If the unit changes more than this, turn AFC off and peak the MC-50at 150.0 MHz, the needle should read +20 dBmV on the meter. Turn AFC on and peak the RF tuning caps on the front of the RF assembly. Peak the tuning caps on the back of the RF first.

IV TESTING PROGRAM MODE

Place PGM/MAN switch in PGM. AFC should be on.

	PRESS	LCD WILL DISPLAY
1.	1, CHN	41.2
2.	2, CHN	59.7
3.	NEXT	65.7
4.	2, CHN HRC	58.5
5.	NEXT	64.5
6.	4,0, CHN	323.7
7.	NEXT	329.7
8.	4,0, CHN/HRC	322.5
9.	NEXT	328.5
10.	6,0,CHN	443.7
11.	NEXT	449.7
12.	6,0,CHN HRC	442.5
13.	NEXT	448.5
14.	Place PIX/SND Switch to PIX	444.0
15.	NEXT	Blank
16.	1,CHN	45.7

SELECTED ANALOG CHANNEL	ADDRESS LINE A	B	C	DESCRIPTION
IN0	L	L	L	SPARE
IN1	L	L	H	SIGNAL LEVEL
IN2	L	H	L	HUM
IN3	L	H	H	ATTENUATOR
IN4	H	L	L	BATTERY
IN5	H	L	H	TEMP
IN6	H	H	L	SPARE
IN7	H	H	H	SPARE

TABLE 1

Selected Diagnostic Routine	EF1 PIX/SND	EF3 PGM/MAN	Keyboard Entry
LCD Display Check	SND	MAN	N/A
Keyboard Entry Check	SND	PGM	All Keys
C A L I B R A T I O N F U N C T I O N M O D E S			
Signal Slope (R2)	PIX	MAN	N/A
High Frequency (R_{21})	PIX	PGM	1
Low Freq Adjust (R25)	PIX	PGM	2
Temp Adjust (R8)	PIX	PGM	3
Reserved For Future	PIX	PGM	4 - 9

TABLE 2

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SELECT N LINE	$\overline{MRD}$	$\overline{MWR}$	DESCRIPTION
1	-	X	A/D Convertor Data to BUS [IC3]
1	X	-	Control Data From BUS [IC4]
2	-	X	Frequency [MSD] Data to BUS [IC11]
2	X		DAC 1 Control Data From BUS [IC13]
3		X	Frequency [LSD] Data to BUS [IC12]
3	X	-	DAC 2 Control Data From BUS [IC14]
4		X	Window and Keyboard Data to BUS [IC7 & P12-16]
4	X	-	LCD Control Data From BUS [P12 - 10]

TABLE 3

DATA BUS BIT	IC4 PIN	DESCRIPTION
0	4	Analog Channel Select A
1	6	Analog Channel Select B
2	8	Analog Channel Select C
3	10	Start Conversion Pulse
4	15	Frequency Reset Pulse
5	17	Window Inhibit Pulse
6	19	Hum Relay Pulse
7	21	Spare

TABLE 4

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TABLE 5

CONNECTOR	PIN	FUNCTION	LOGIC (VOLT)	MISCELLANEOUS
P5	1	SIGNAL LEVEL	(1)	SL
P5	2	HUM LEVEL	(1)	HL
P5	3	SPARE		
P5	4	SPARE		
P5	5	BATTERY STATUS	(1)	BS
P5	6	GROUND		
P5	7	SPARE		
P5	8	ATTENUATOR SENSE	(1)	AS
P5	9	+5Volt		
P5	10	HUM RELAY OUTPUT	12	HR
J4	1	GROUND		
J4	2	LAMP POWER		LP
J4	3	PLUS SIX VOLTS		+ 6V
J4	4	PLUS TWELVE VOLTS		+12V
J4	5			
J4	6			
J4	7			
J4	8	SPARE		
J4	9	BATTERY TERMINAL		BT
J4	10			
P22	1	FREQUENCY INPUT		
P22	2	GROUND		
J23	1	SWITCHER PLUS FIVE		
J23	2	LOAD OUTPUT		

NOTE: (1) See Analog Transfer Curves

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CONNECTOR	PIN	FUNCTION	LOGIC (VOLT)	MISCELLANEOUS
P12	1	LCD GROUND	- - -	- - - - - - - -
P12	2	LAMP POWER	- - -	- - - - - - - -
P12	3	SPARE	- - -	- - - - - - - -
P12	4	DISPLAY FREQ ONE	5	DF1
P12	5	SERIAL DATA OUT	5	SDO
P12	6	SERIAL DATA IN	5	SDI
P12	7	DATA BUS ZERO	5	DØ
P12	8	DISPLAY FREQ TWO	5	DF2
P12	9	DATA BUS ONE	5	D1
P12	10	OUTPUT FOUR	5	OUT 4
P12	11	DATA BUS TWO	5	D2
P12	12	MINUS FIVE VOLT	-	-5V
P12	13	DATA BUS FOUR	5	D4
P12	14	DATA BUS FIVE	5	D5
P12	15	DATA BUS SEVEN	5	D7
P12	16	INPUT FOUR	5	$\overline{IN4}$
P12	17	PLUS FIVE VOLT	-	+5V
P12	18	DATA BUS SIX	5	D6
P12	19	DATA BUS THREE	5	D3
P12	20	DATA AVAILABLE	5	DA
J20	1	NORMAL MODE	5	J20-1 to J20-2
J20	2	DIAGNOSTIC SENSE	-	———————
J20	3	DIAGNOSTIC MODE	0	J20-2 to J20-3
J21	1	NORMAL	-	J21-1 to J21-2
J21	2	INTERRUPT SENSE	-	———————
J21	3	STANDBY MODE	-	J21-2 to J21-3

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Terminal Assignments for the RCA CDP1802 COSMAC Microprocessor

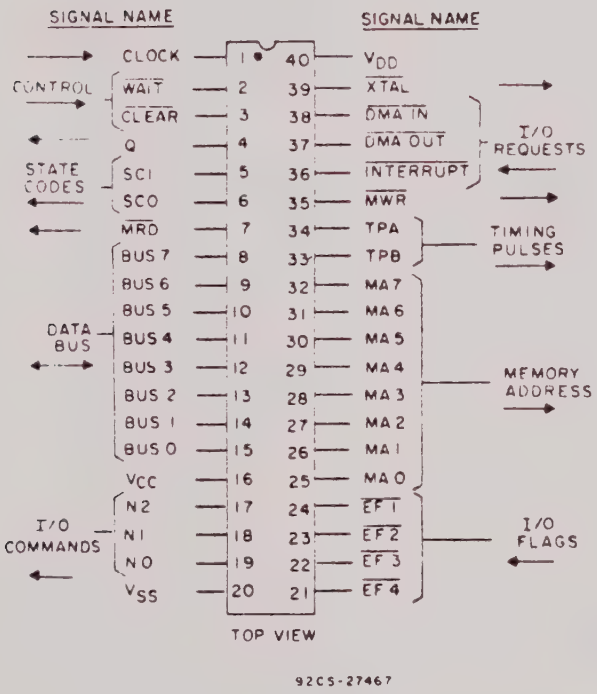


FIGURE 1

KEYBOARD CONFIGURATION

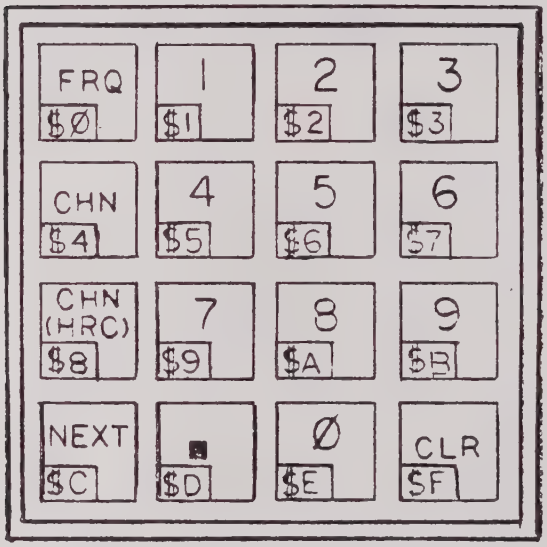
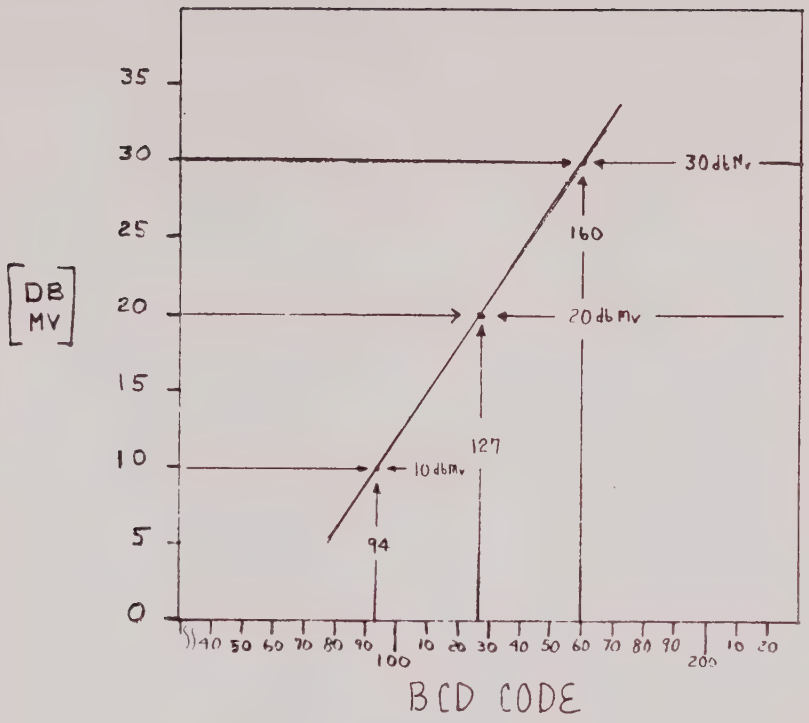


FIGURE 3



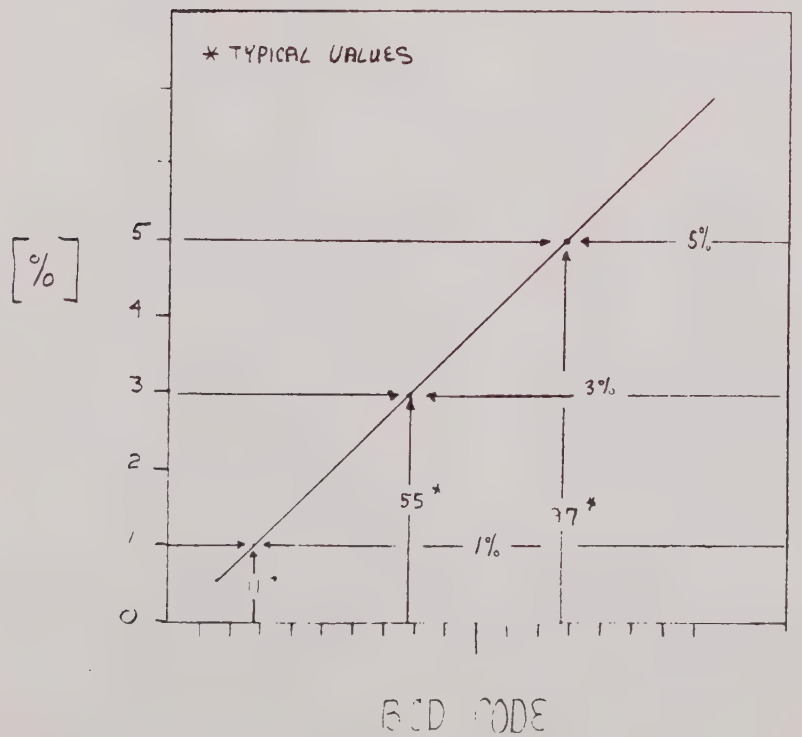
PLOT 1a

RF SIGNAL
VS
A/D CODE

$Y = 0.303 X - 18.48$

Y = DB MV

X = BCD CODE



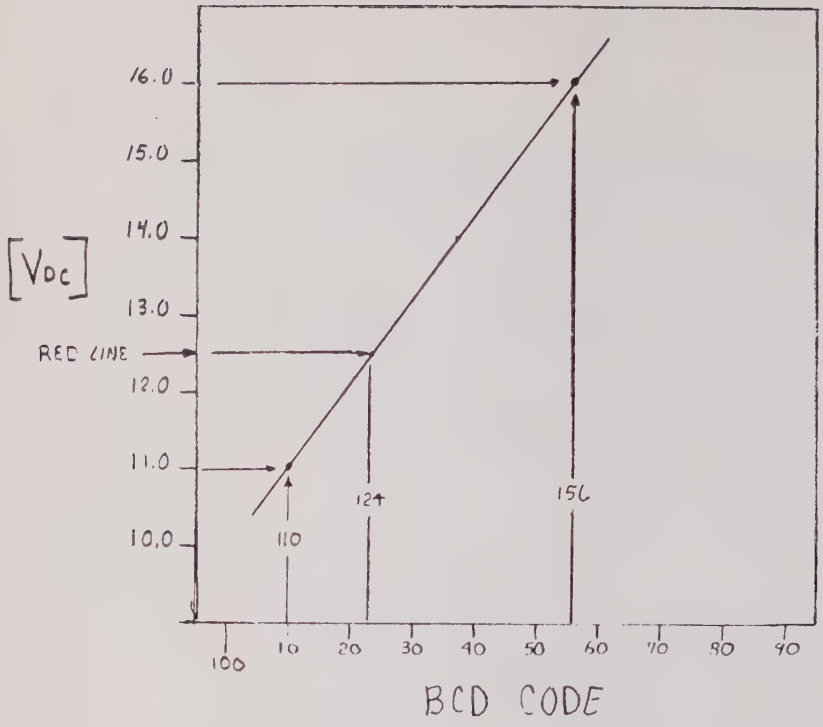
PLOT 1b

% HUM
VS
A/D CODE

$Y = .046 X + 0.54$

Y = %

X = BCD CODE



PLOT 1c

BATTERY
VS
A/D CODE

$Y = .109X - 0.942$

Y = VDC

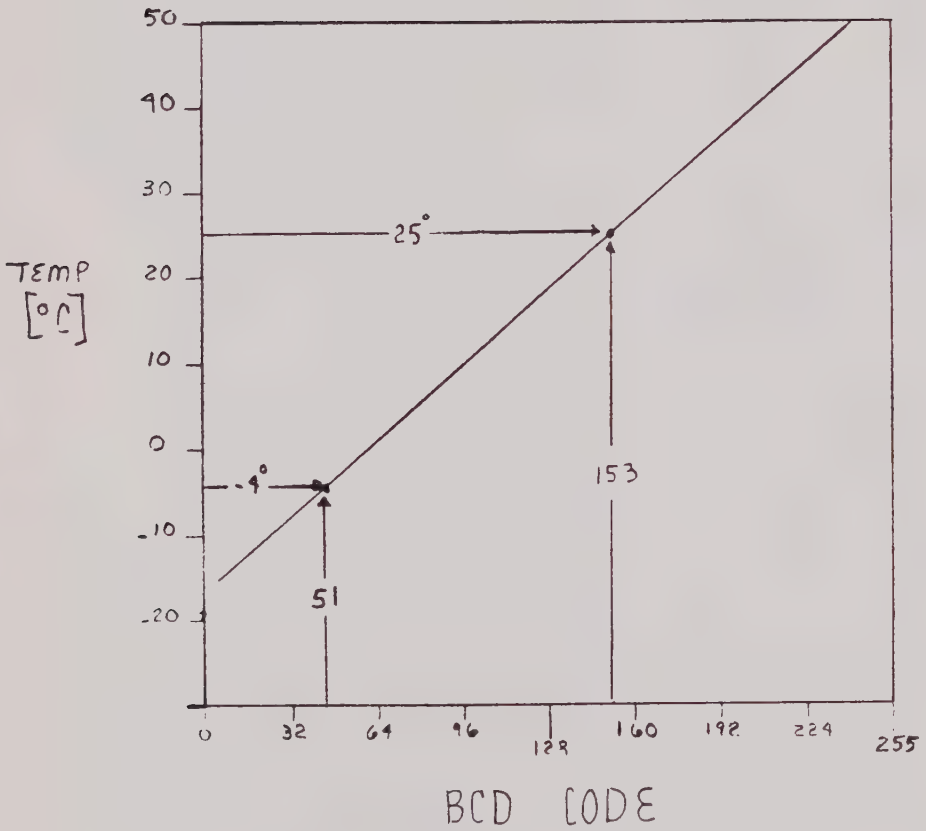
X = BCD CODE

ATTENUATOR POSITION [DB]	BCD CODE
-25 TO -15	144
-15 TO -5	160
-5 TO +5	176
+5 TO +15	192
+15 TO +25	208
+25 TO +35	223
+35 TO +45	239
+45 TO +55	255

PLOT 1d

ATTENUATOR
VS
A/D CODE

NOTE: BCD TO VOLTAGE CONVERSION FOR ALL PLOTS IS 19.6 mV/BIT $\therefore$ FF = 256 = 5.00 VDC.



Plot le

TEMP

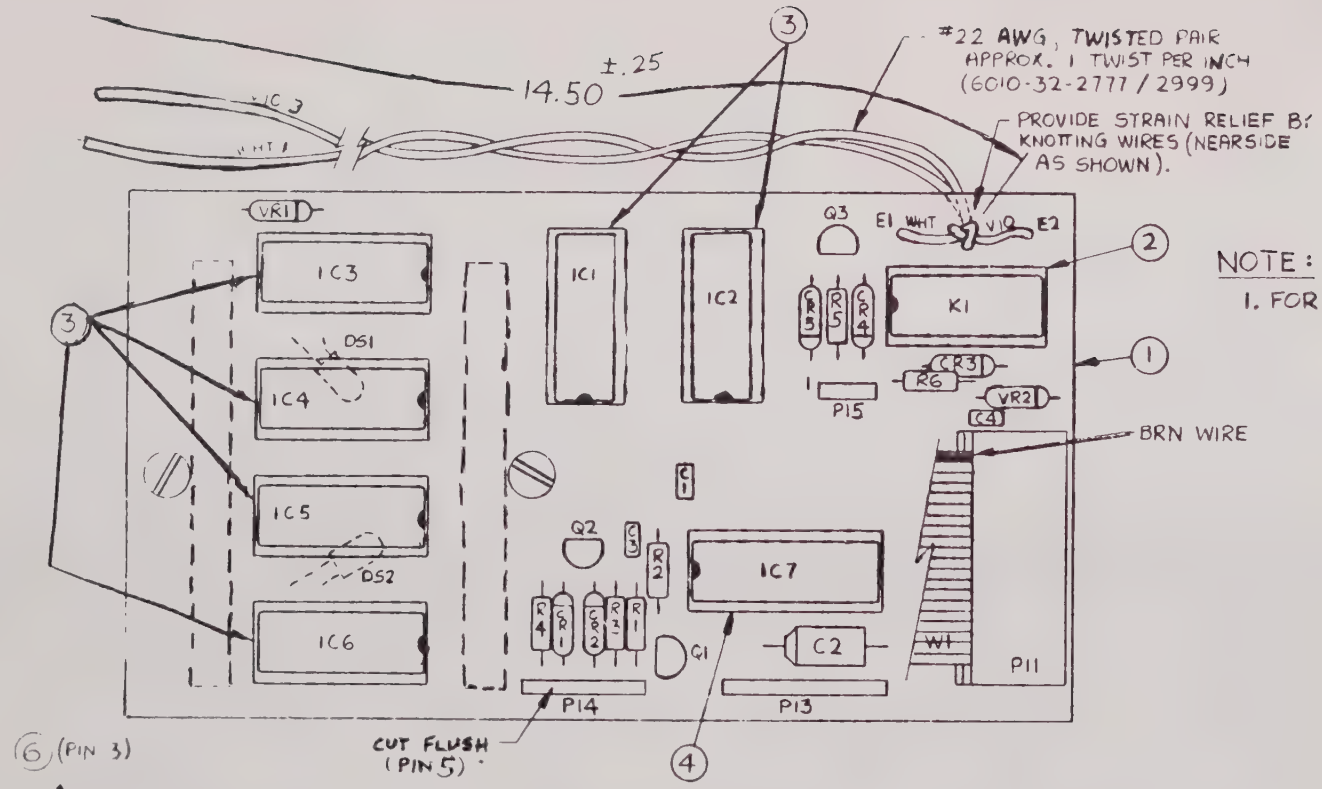
VS

B/D CODE

$Y = .284\,X - 18.45$

Y = Temp °C

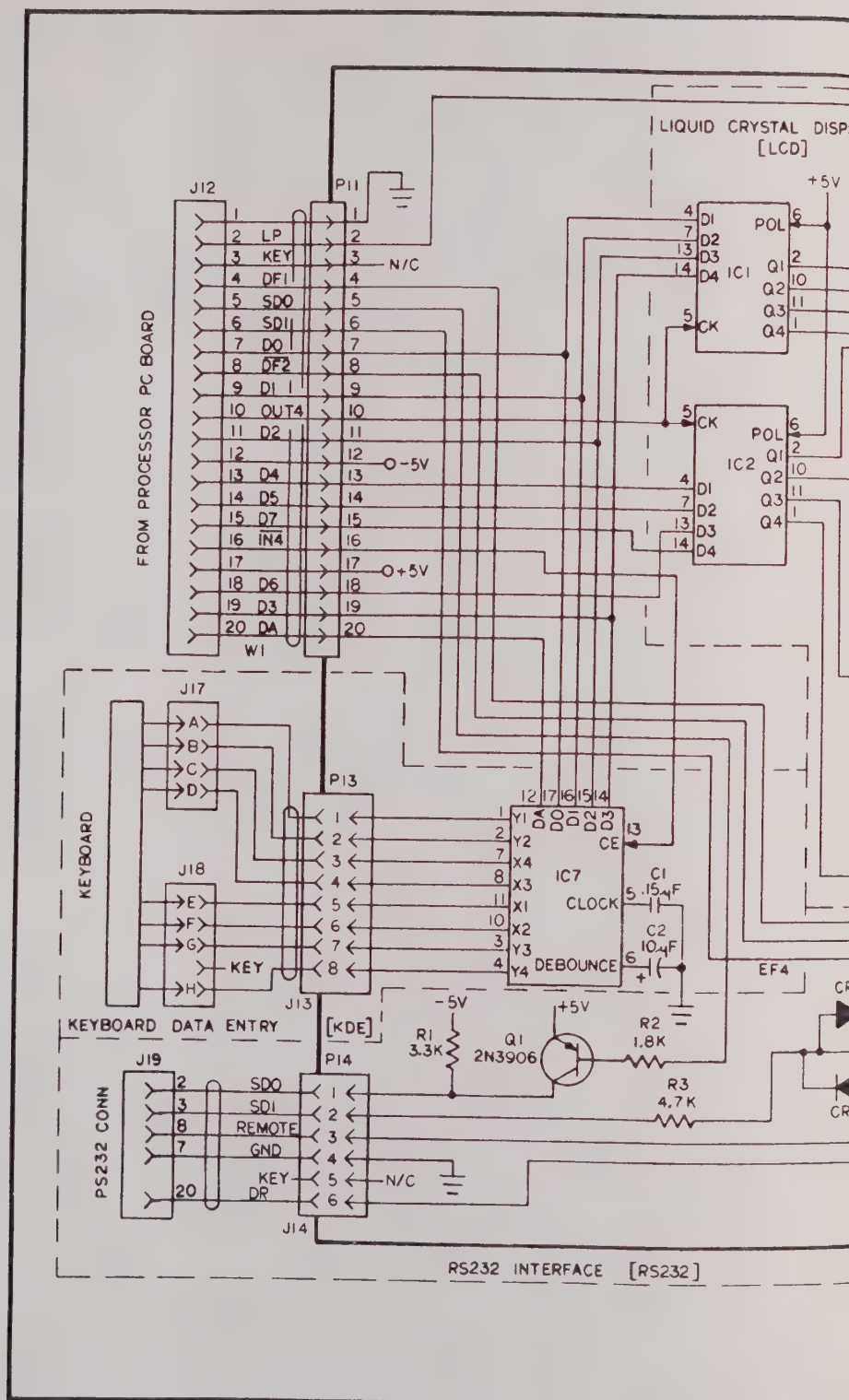
X = BCD CODE

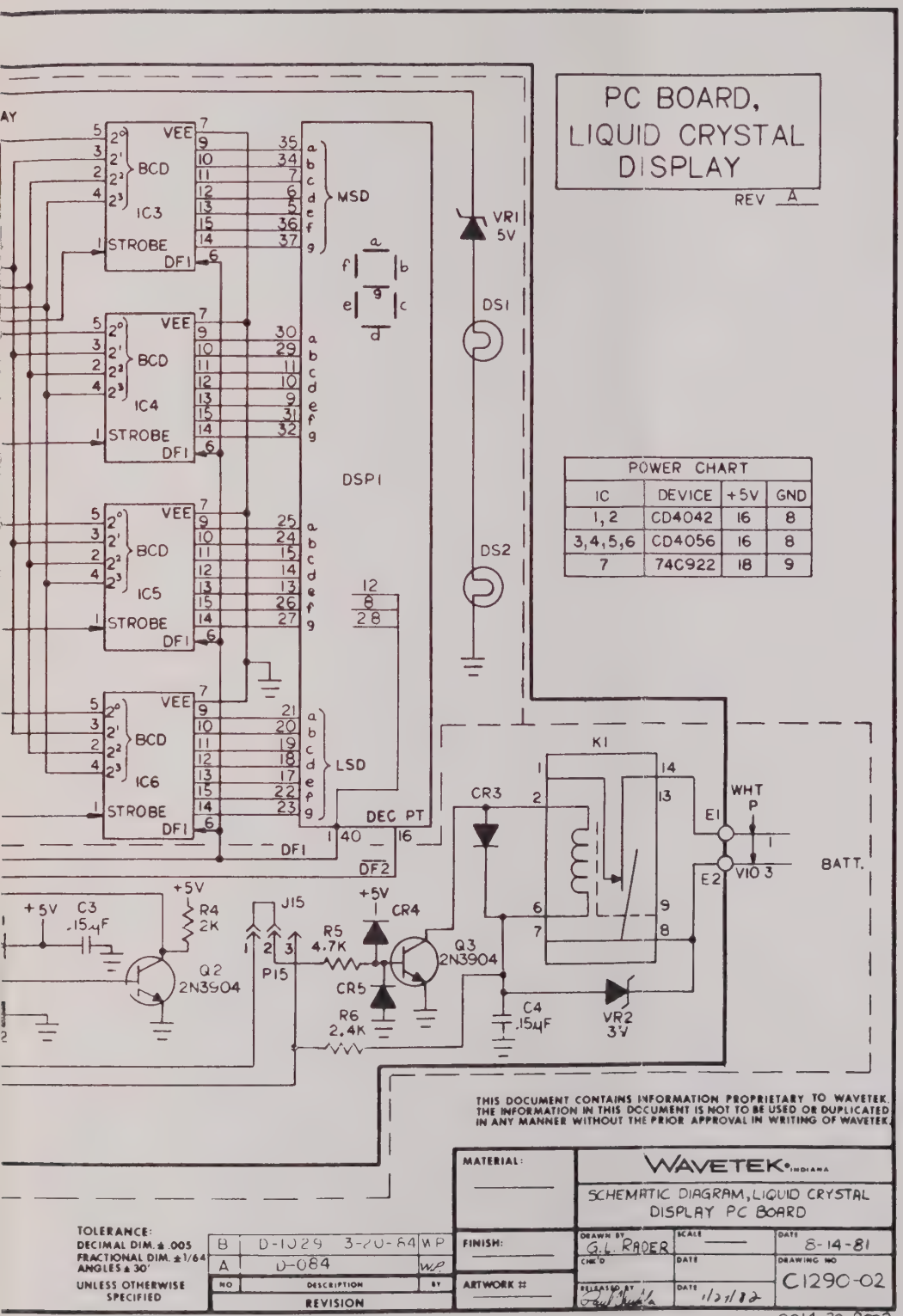


NOTE:

1. FOR PL SEE 1110-00-9007

REVISIONS			WAVETEK
	ECN'S	BY	
A	0-1014	[illegible]	ASSEMBLY DRAWING, LIQUID CRYSTAL DISPLAY PC BOARD
B	C1029	[illegible]	
C			DRAWN BY: — DATE: — NUMBER: —
D			G.L. RADER — 12-21-81 — 0012-10-9011
E			APP'D — [illegible] 1/29/82


LIQUID CRYSTAL DISP
[LCD]
+5V
J12
P11
FROM PROCESSOR PC BOARD
2 LP
3 KEY
4 DF1
5 SDO
6 SDI1
7 DO
8 DF2
9 DI
10 OUT4
11 D2
12
13 D4
14 D5
15 D7
16 IN4
17
18 D6
19 D3
20 D4
W1
N/C
-5V
+5V
IC1
IC2
DI
D2
D3
D4
CK
POL
Q1
Q2
Q3
Q4
J17
A
B
C
D
J18
E
F
G
H
KEY
KEYBOARD
P13
J13
KEYBOARD DATA ENTRY
[KDE]
IC7
Y1
Y2
X4
X3
X1
X2
Y3
Y4
CE
CLOCK
DEBOUNCE
C1
.15μF
C2
10μF
EF4
-5V
+5V
R1
3.3K
Q1
2N3906
R2
1.8K
R3
4.7K
J19
PS232 CONN
SDO
SDI
REMOTE
GND
KEY
DR
N/C
P14
J14
RS232 INTERFACE [RS232]


PC BOARD,
LIQUID CRYSTAL
DISPLAY
REV A
IC3
IC4
IC5
IC6
BCD
STROBE
DF1
VEE
MSD
LSD
DSP1
DEC PT
VR1
5V
DS1
DS2
POWER CHART
IC | DEVICE | +5V | GND
1, 2 | CD4042 | 16 | 8
3,4,5,6 | CD4056 | 16 | 8
7 | 74C922 | 18 | 9
K1
CR3
E1
E2
WHT
P
VIO 3
BATT.
+5V
C3
.15μF
R4
2K
Q2
2N3904
J15
P15
R5
4.7K
CR4
CR5
R6
2.4K
Q3
2N3904
C4
.15μF
VR2
3V
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MATERIAL:
FINISH:
ARTWORK #
WAVETEK INDIANA
SCHEMATIC DIAGRAM, LIQUID CRYSTAL DISPLAY PC BOARD
DRAWN BY G.L. RADER
DATE 8-14-81
CHK'D
DATE
DRAWING NO C1290-02
RELEASED BY
DATE 1/21/82
TOLERANCE:
DECIMAL DIM. ± .005
FRACTIONAL DIM. ± 1/64
ANGLES ± 30'
UNLESS OTHERWISE SPECIFIED
B D-1029 3-20-84 WP
A D-084 WP
NO DESCRIPTION BY
REVISION
0014-20-9002

frequency is 1801 degrees out of phase with the display frequency input. The display frequency is a square wave at a frequency of 61 Hz. In order to provide a decimal point, it was necessary to add a display frequency bar (DF2). DS1 and DS2 provide a means to illuminate the Liquid Crystal Display (DPS1) at night and also provides increase residual ambient temperature for the crystals when used in colder environments.

4.2 KEYBOARD DATA ENTRY (KDE)

The KDE consists of IC7 which provides all the necessary logic to fully encode an array of SPST switches. An internal debounce circuit along with a data available (DA) output and O/Chip Clock provide the power to encode a total of 16 key entries. As data is entered via keyboard, the data available (DA) output goes high and alerts the microprocessor of a new entry. The microprocessor will then select the Output Enable (OE) which will transfer the data from the keyboard encoding logic to the data bus for interrogation by the CPU of the microprocessor.

4.3 RS232 INTERFACE (RS232)

The RS232 Interface consists of two (2) parts. The serial input/output circuit and the remote power 'on' circuit.

4.3.1 SERIAL INPUT/OUTPUT CIRCUIT (SD1/SD0)

The SDI/SDO consists of Q1 and Q2. Data enters (SDI) the microprocessor via EF4 and exits (SDO) via the Q line. Since the microprocessor handles all the data and interfaces, the only requirement of the serial Input/Output is to transfer the signal levels from the RS232 connector which is a plus/minus level to a zero and one bit code.

4.3.2 REMOTE POWER 'ON'CIRCUIT

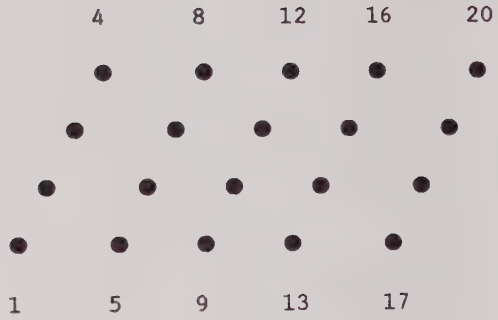
The Remote Power 'ON' Circuit consists of K1 and Q3. When a positive signal is recived via Pin 8 on the RS232 connector, a closure will occur at terminal E1 and E2 which will by-pass the on/off switch on the Sam IIID/Sam IV and activate the microprocessor package. A data ready (DR) signal is provided for a modem on J19 - 20 via R6 on LCD Board.

The type of modem being used, will determine which configuration the shorting jumper is in.

4.3.3 ADDRESS INTERFACE

The Address Interface provides a means to decode the address lines from the microprocessor and react when a particular address is sensed. There are two primary chip selects on the LCD Board. When the microprocessor desire to make a deposit to the liquid crystal, it addresses IC1 and IC2. When the microprocessor desires to receive information from the keyboard, it addresses IC7. The data bus provides the key information for the microprocessor to respond to commands or executions. The are a total of 8 bits (D0-D7) which are used to communicate. The LCD uses 4 bits (D0-D3) for coding the segments of the LCD and 4 bits (D4-D7) for coding the digits to be selected. The keyboard data requires only 4 bits (D0-D3) for identification of key depressed and 1 bit (D4) indicating that data is available (DA) for the microprocessor to interrogate. The decoding for the LCD and Keyboard is an 'Output 4' which defines the LCD and Keyboard to the microprocessor.

LCD SIGNALS



1 Ground
2 0 (15V W/Lamp Test)
3 N/C
4 5V Square Wave
5 5V (Alternates W/Test 3)
6 5V
7 Data
8 5V Square Wave
9 Data
10 Sync Pulse
11 Data
12 -10V
13 Data
14 Data
15 Data
16 5V
17 5V
18 Data
19 Data
20 0 (Goes High When Key Pushed)

REMOTE OPERATION CHECK

1. Place function switch to SLM Mode.

2. Put PGM/MAN switch to PGM.

3. With AFC on, set attenuator to +15 - +25 range.

4. Plug RT-1 into the Sam RS-232 connector.

5. Turn RT-1 on, the Sam IIID should come on and display 55.2.

6. Depress 1, then OPT on the RT-1, should display battery voltage on RT-1.

7. Depress 2, then OPT on RT-1, should display Hum, the reading should be less than or equal to 13.0.

8. Depress 3, then OPT on RT-1, should display the temperature-in Celcius.

9. Depress 4, then OPT on RT-1, should display the attenuator setting of the upper window of the Sam IIID. Rotate the attenuator through all steps and check each step with the RT-1.

10. Use an MC-50 set at 150.0 MHz and +20 dBmV output. Place the RF out of the MC-50 to RF in of the Sam. Depress 1, 5, 0 on the RT-1, then FREQ, should display +20 dBmV ±.6 dBmV.

11. Turn RT-1 off, the Sam IIID should shut off.

THEORY OF OPERATION SAM IV SCOPE

This section first presents an overall block diagram analysis followed by a more detailed description of each block. Refer to the block diagram. The CRT (cathode ray tube) is the heart of the display. The composite signal of all inputs to the instrument is displayed on the face of the CRT.

The Power Supply and its associated regulators provide the instrument with seven voltage sources. The ±30 volt supplies are unregulated. The ±15 volt supplies are IC regulated, and the +68 volt supply is Zener stabilized. There is also a ±30 volt switched supply.

The High Voltage supply provides +8 kV to the anode of the CRT. The power source for this section is the +30 volt supply. The High Voltage supply also provides +100 V for G2 and 0 to +165 V for G4 (the focusing electrode) of the CRT.

The Vertical Amplifier converts the input voltage into a current signal for the vertical deflection yoke. The Vertical Amplifier controls the gain and the position of the vertical display on the CRT.

The Horizontal Amplifier converts the input voltage signal to a corresponding current signal for the horizontal deflection yoke. The Horizontal Amplifier has controls for adjusting the gain and position of the horizontal display on the CRT.

The Auto Blanking circuit turns off the electron beam on the retrace portion of the ramp. This ramp is provided by pin 7 of IC13.

The power transformer is located on the rear panel while the rectifier diodes, regulators, and filter capacitors are located on the Power Supply Blanking Board. The outputs are +30 V unregulated DC, and ±15 V and +68 V regulated DC, and ±30 V DC switched. A dual-primary transformer, T1, allows for a line voltage of either 115 or 230 VAC. The 48 V secondary is center tapped to allow for two full-wave rectified voltages. Unregulated ±30 V are filtered by C8, C9 and C10 and C11 respectively. The ±15 V supplies are IC regulators powered by the ±30 V supply. The 68 V supply is Zener diode regulated. The ±30 V switched is used in the analyzer mode only.

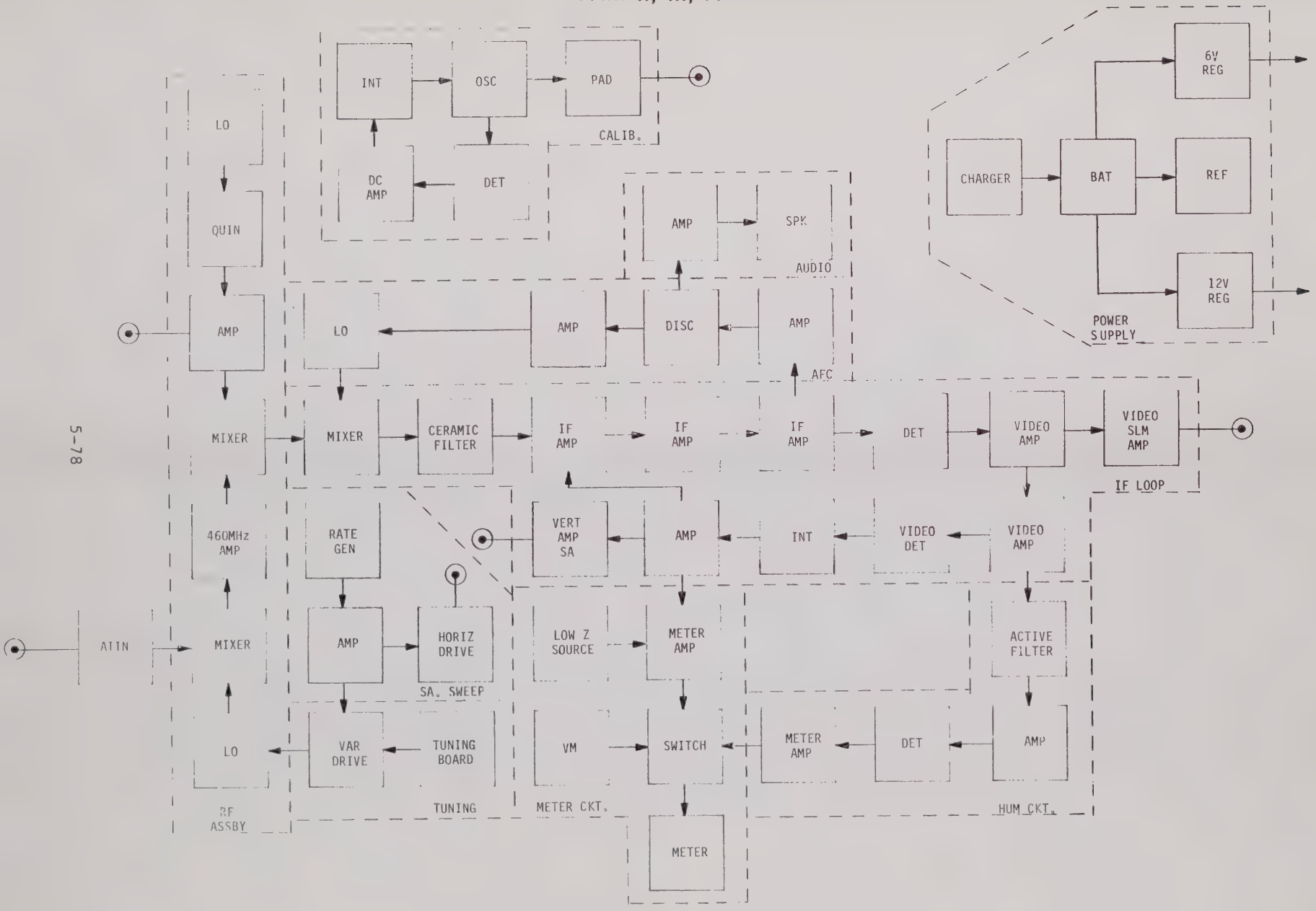
The High Voltage circuit is located away from the main printed-circuit board, and housed in a shielded enclosure to prevent 20 kHz radiation. The high voltage circuit contains transistors Q1, Q2, and Q3. It provides 8 kV to the CRT anode, as well as the voltage for the focusing electrode (G4) and +100 V for G2. Q3 is the heart of a ringing choke oscillator that develops a 20 kHz signal across T1. The oscillator signal is stepped up from 14 Vp to 2 kVp in the secondary of the transformer. It is then increased to +8 kV DC by the cascade quadrupler. The oscillator signal is stepped up to 310 Vp in the other secondary and rectified by CR3. The 310 volts is then fed to the Focus control, R5. The 100 volt supply is derived from a voltage divider on the 310 volt output. Q1 and Q2 provide the supply voltage to the oscillator. This voltage is varied by a feedback signal in order to maintain a constant output level from the oscillator. The feedback is taken from R3, which is also the High Voltage adjustment. As the 8 kV supply is loaded, a bigger load is seen by the oscillator. This temporarily lowers the oscillator supply voltage,

consequently coupling less voltage to the 310 V circuit. This results in a lower voltage at R3. This lower voltage is inverted and amplified to provide a larger supply to the oscillator, thus correcting for the additional loading.

The Vertical Amplifier consists of IC1, Q1 through Q6. The input signal is connected directly across Vertical Gain control R1, which feeds a selected portion of the input signal to IC1A. This operational amplifier acts as a buffer for the vertical input signal. The output is then routed to an inverting operational amplifier, IC1B. The other inputs to IC201B are the vertical position bias and the feedback voltage, which is proportional to the current signal through vertical yoke L1A. The circuit consisting of R6, R7, R8, CR9, CR10, CR11, and CR12. The output of IC1B drives a complementary symmetry push-push amplifier consisting of Q1, Q2, Q3, Q4, Q5, and Q6. This provides the high current gain necessary for driving vertical yoke L1A. Q5 and Q6 provide current limiting for Q1 and Q2 to prevent damage to the power transistors when the incoming signal is sufficient to deflect the display off the CRT face.

Q1 and Q2 are located on the heat sink. Vertical yoke L1A provides the magnetic field for vertical deflection of the electron beam.

The Horizontal Amplifier consists of IC2, Q7, Q8, Q9, and Q10. The horizontal input signal is fed directly to Horizontal Gain control R3, which feeds a selected portion of the input signal to IC2A which acts as a buffer for the horizontal input signal. The output is then fed to IC2B along with the horizontal position bias and the feedback voltage. The circuit consisting of R30, R39, R40, CR23, CR24, CR26 and CR29 improves display linearity during the furthest excursion of the signal. The output of IC2B drives a complementary symmetry push-pull amplifier consisting of Q7, Q8, Q9, and Q10. This amplifier provides the high current gain necessary for driving horizontal yoke L1B. Horizontal yoke L1B provides the magnetic field for horizontal deflection of the electron beam.


INT
OSC
PAD
CALIB.
DC AMP
DET
LO
QUIN
AMP
SPK
AUDIO
6V REG
CHARGER
BAT
REF
12V REG
POWER SUPPLY
LO
AMP
DISC
AMP
AFC
MIXER
MIXER
CERAMIC FILTER
IF AMP
IF AMP
IF AMP
DET
VIDEO AMP
VIDEO SLM AMP
IF LOOP
460MHz AMP
RATE GEN
VERT AMP SA
AMP
INT
VIDEO DET
VIDEO AMP
ANTIN
MIXER
AMP
HORIZ DRIVE
LOW Z SOURCE
METER AMP
ACTIVE FILTER
SA. SWEEP
LO
VAR DRIVE
TUNING BOARD
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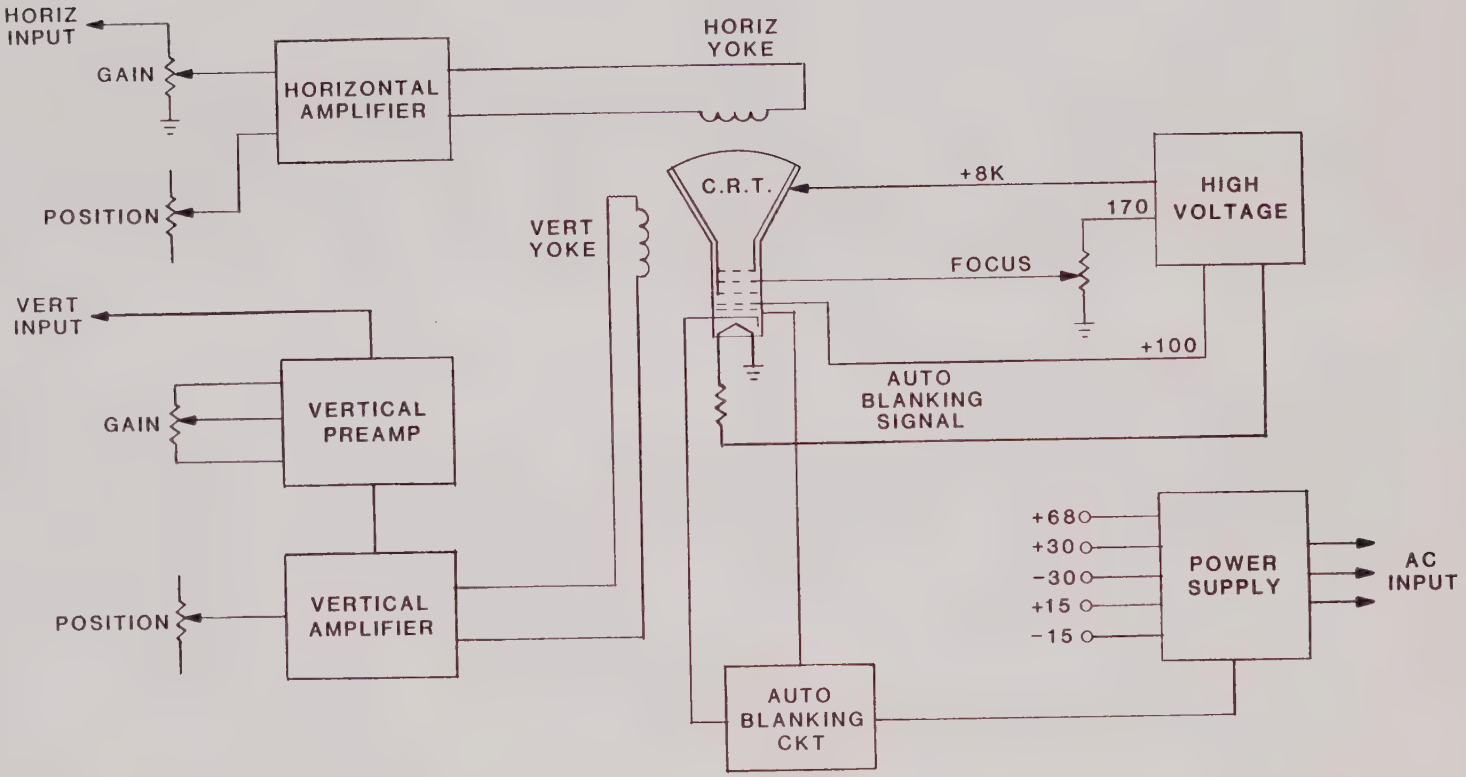
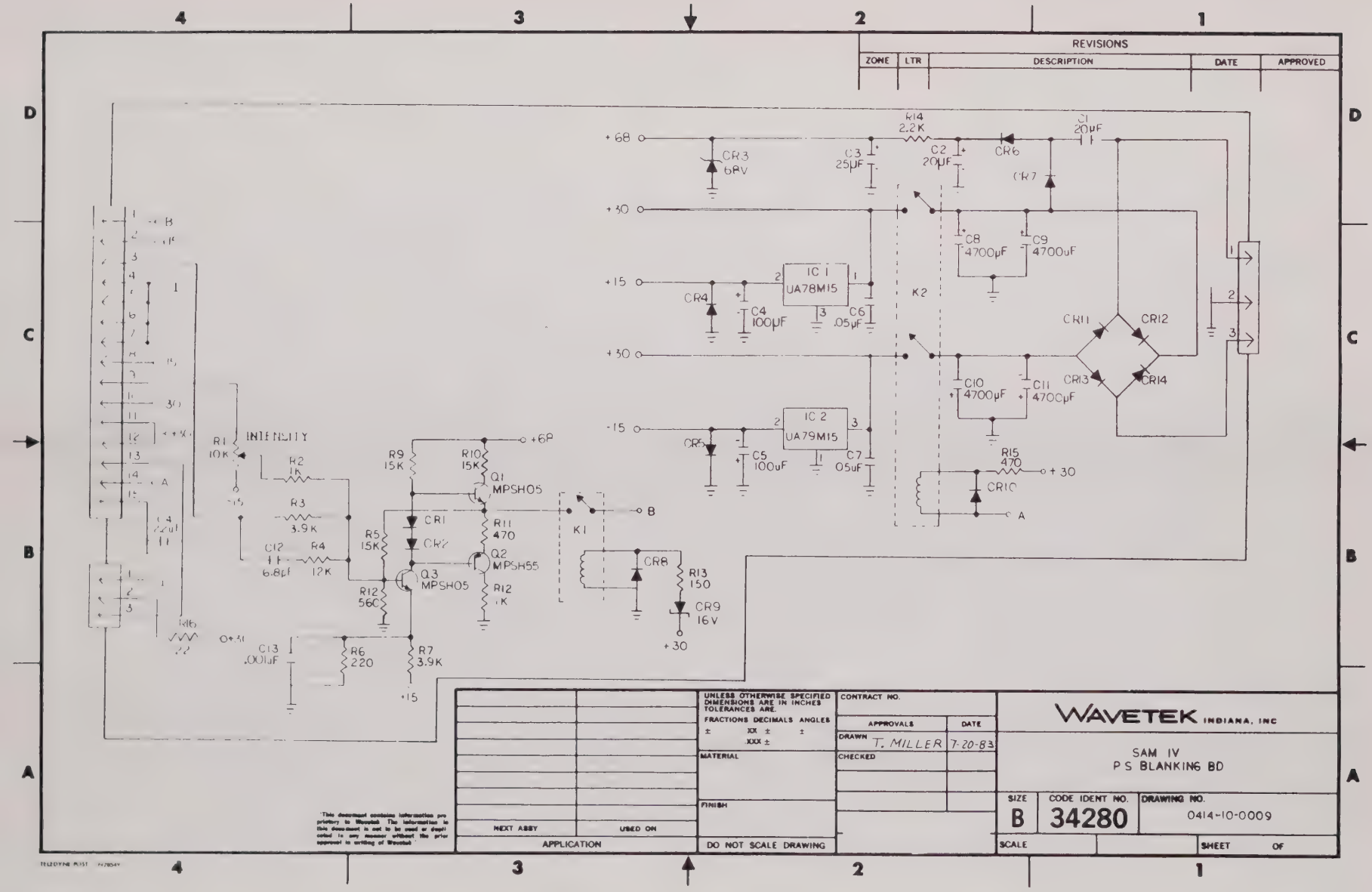
HUM CKT.
METER

SIMPLIFIED BLOCK DIAGRAM




REVISIONS
ZONE
LTR
DESCRIPTION
DATE
APPROVED
+68
+30
+15
-15
CR3
6.8V
C3
25µF
R14
2.2K
C2
20µF
CR6
C1
20µF
CR7
C8
4700µF
C9
4700µF
IC 1
UA78M15
CR4
C4
100µF
C6
.05µF
K2
CR11
CR12
CR13
CR14
C10
4700µF
C11
4700µF
IC 2
UA79M15
CR5
C5
100µF
C7
.05µF
R15
470
CR10
A
INTENSITY
R1
10K
R2
1K
R3
3.9K
C12
6.8pF
R4
12K
R9
15K
R10
15K
Q1
MPSH05
CR1
CR2
R11
470
Q2
MPSH55
Q3
MPSH05
R5
15K
R12
560
R12
1K
K1
B
CR8
R13
150
CR9
16V
R16
22
C13
.001uF
R6
220
R7
3.9K
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
± XX ± ±
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WAVETEK INDIANA, INC
SAM IV
P.S. BLANKING BD
SIZE
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DRAWING NO.
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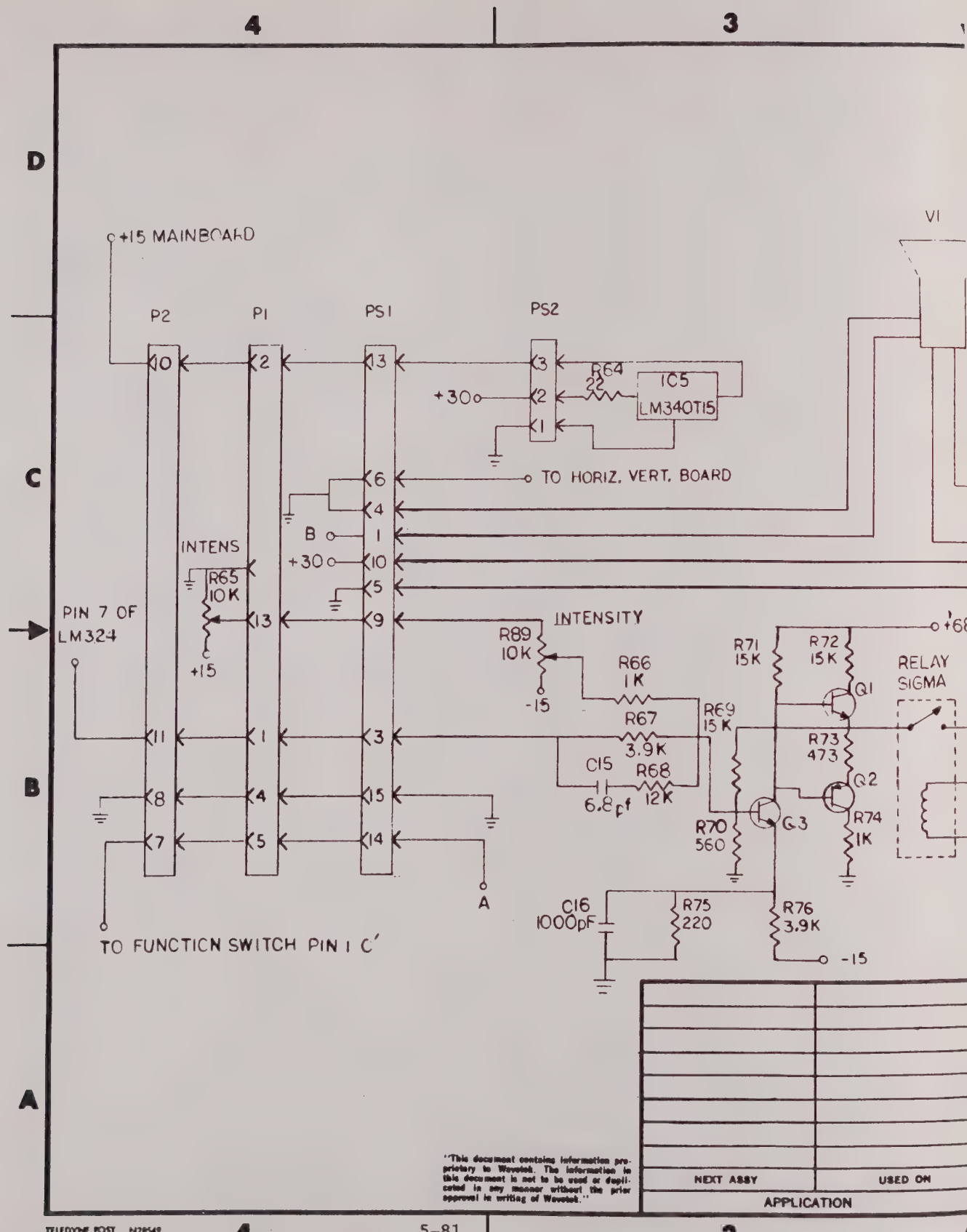
4
3
D
C
B
A
+15 MAINBOARD
P2
P1
PS1
PS2
VI
+30
R64
22
IC5
LM340T15
TO HORIZ. VERT. BOARD
B
INTENS
R65
10K
+15
PIN 7 OF
LM324
INTENSITY
R89
10K
-15
R66
1K
R67
3.9K
C15
6.8pf
R68
12K
R69
15K
R71
15K
R72
15K
Q1
RELAY
SIGMA
R73
473
Q2
R74
1K
R70
560
Q3
C16
1000pF
R75
220
R76
3.9K
-15
A
TO FUNCTION SWITCH PIN 1 C'
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APPLICATION
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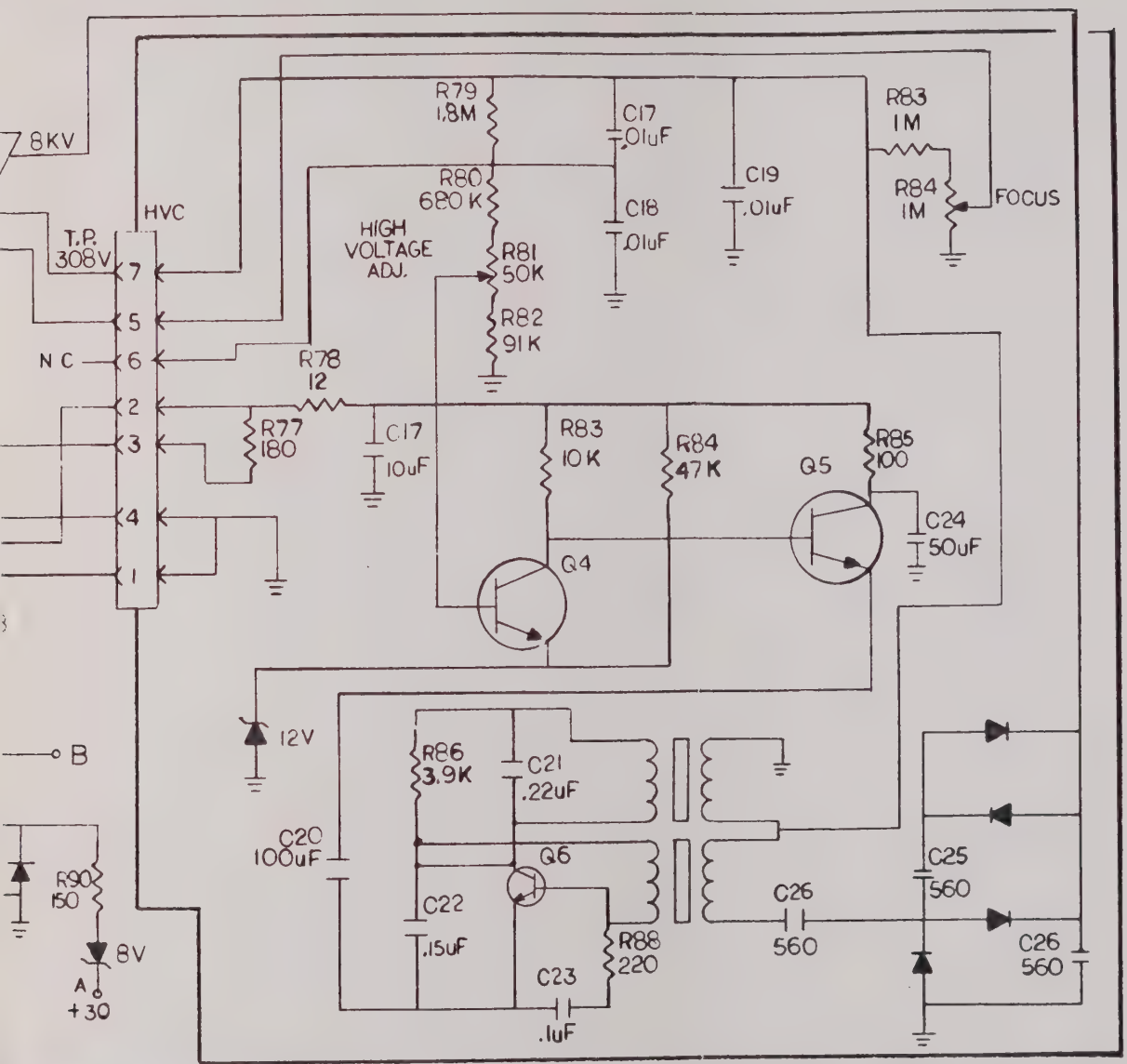

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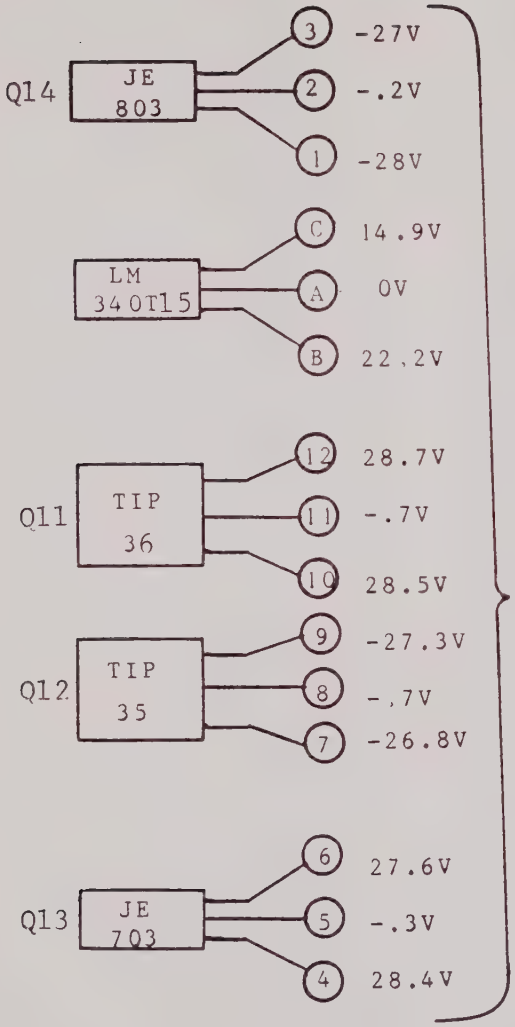
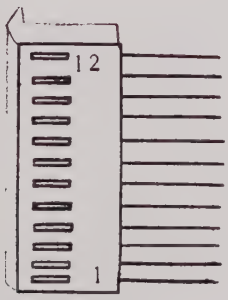
Heatsink

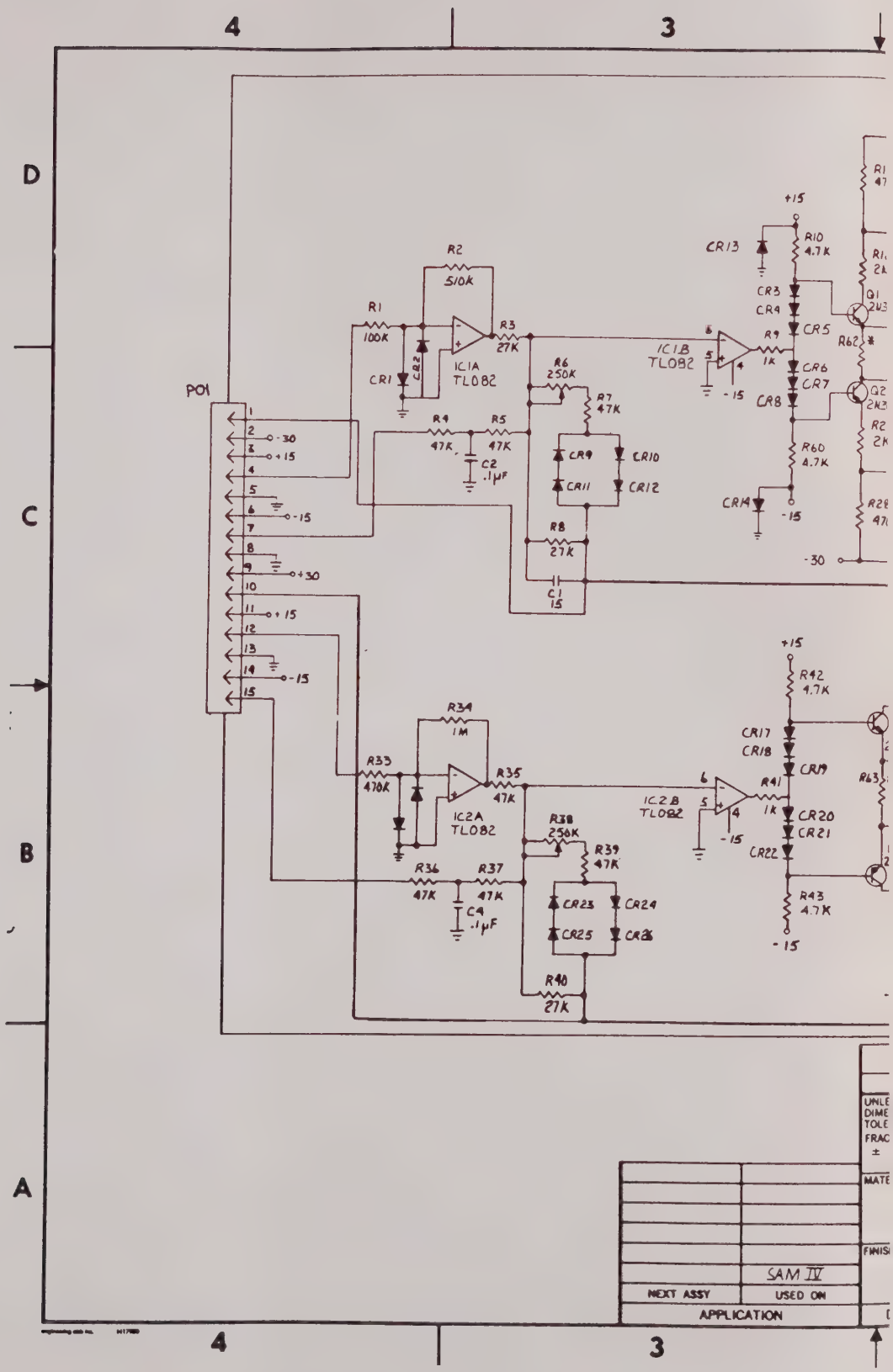


Located On The Heatsink

Located On Power Supply Board



Located On Horiz. Vertical Amp. Board


4
3
D
C
B
A
P01
R1
100K
R2
510K
R3
27K
IC1A
TL082
CR1
CR2
R4
47K
R5
47K
C2
.1μF
R6
250K
R7
47K
CR9
CR10
CR11
CR12
R8
27K
C1
15
IC1B
TL082
CR13
R10
4.7K
CR3
CR4
CR5
R9
1K
CR6
CR7
CR8
R60
4.7K
CR14
+15
-15
-30
+30
R34
1M
R33
470K
R35
47K
IC2A
TL082
R36
47K
R37
47K
C4
.1μF
R38
250K
R39
47K
CR23
CR24
CR25
R40
27K
IC2B
TL082
R42
4.7K
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CR22
R43
4.7K
SAM IV
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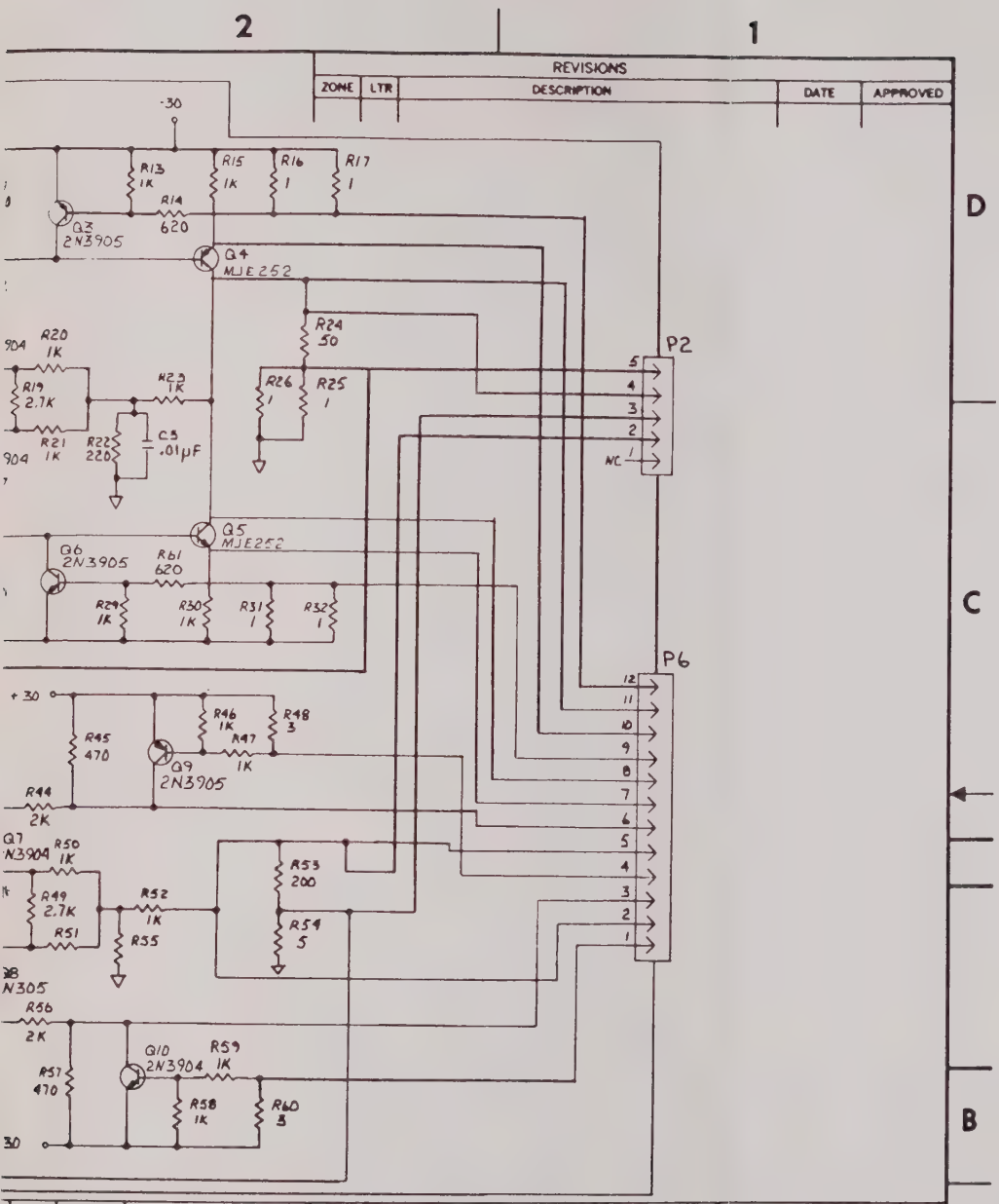
USED ON
APPLICATION



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PARTS LIST

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NSIONS ARE IN INCHES
RANCES ARE:
TIONS DECIMALS ANGLES
.XX ±
.XXX ±
RIAL

APPROVALS	DATE
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CHECKED	

CONTRACT NO.

WAVETEK INDIANA, INC.

VERT HORZ. AMP BD

SIZE	CODE IDENT NO.	DRAWING NO.
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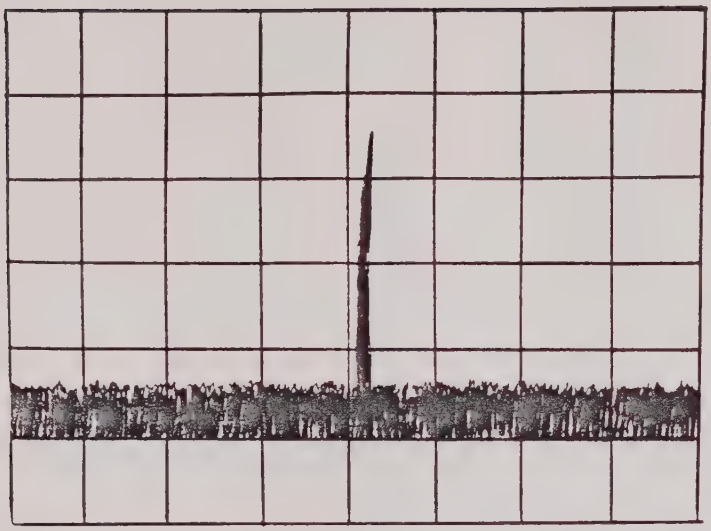
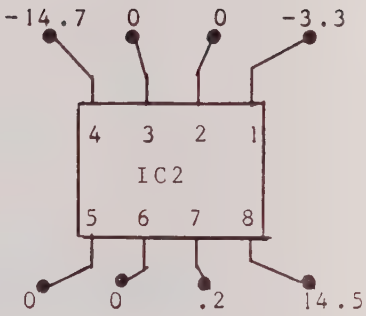
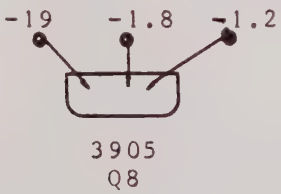
Horizontal



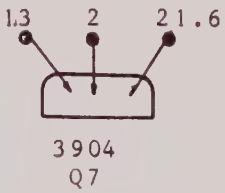


Adjusted For Normal Display

*All Voltages Approximate

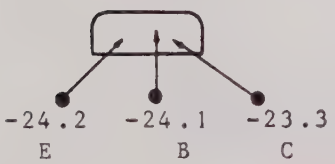


3905
Q8

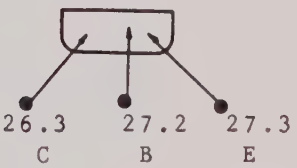


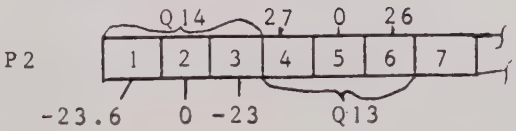
3904
Q7

Q10
3904

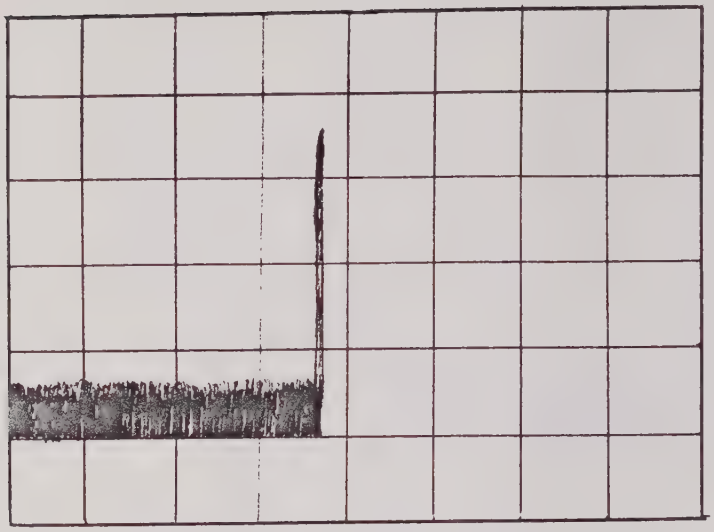


Q9
3905





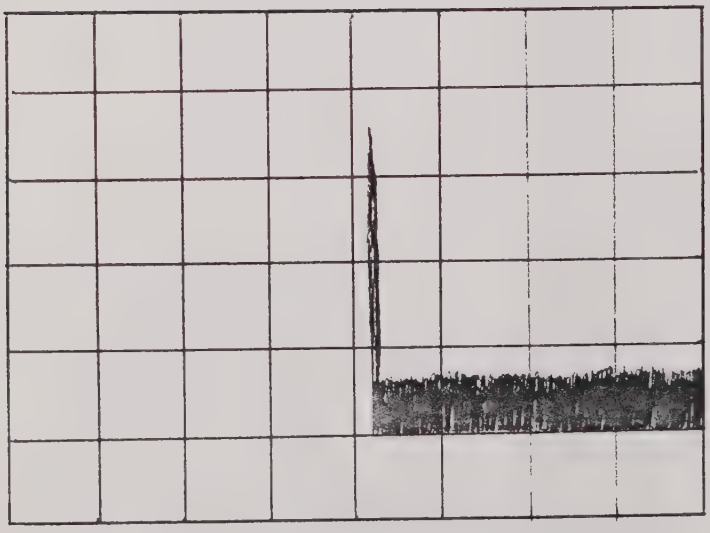
Horizontal Problems



Right Side Bad

Check Q7, Q9 & Q14

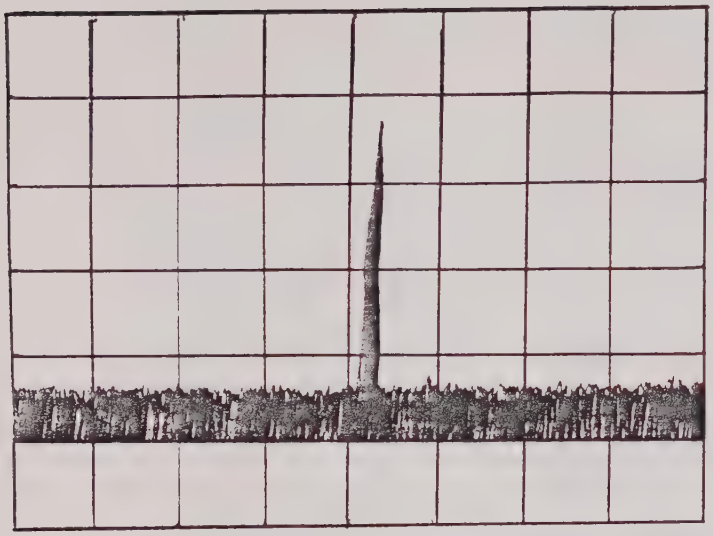
Also R44 (470 ohm)

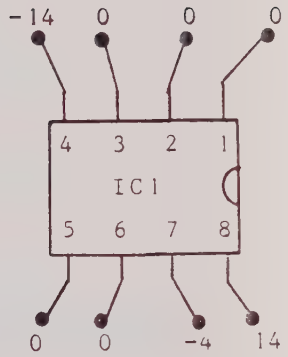


Left Side Bad

Check Q8, Q10 & Q13

Also R57 (470 ohm)

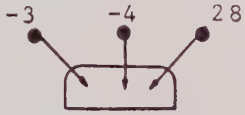




Adjusted For Normal Display

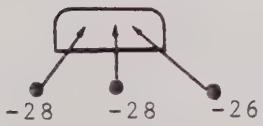
*All Voltages Approximate

3905
Q2

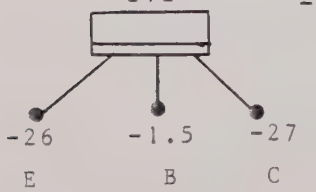


3904
Q1

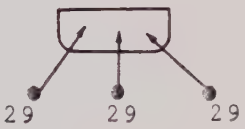
3904
Q6



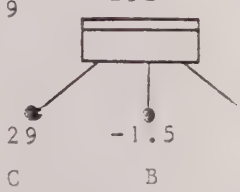
Q5
242



3905
Q3

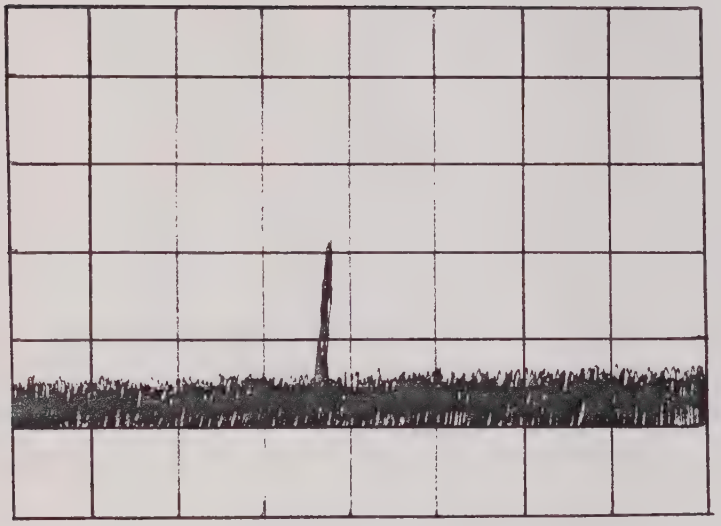


Q4
252



Vertical

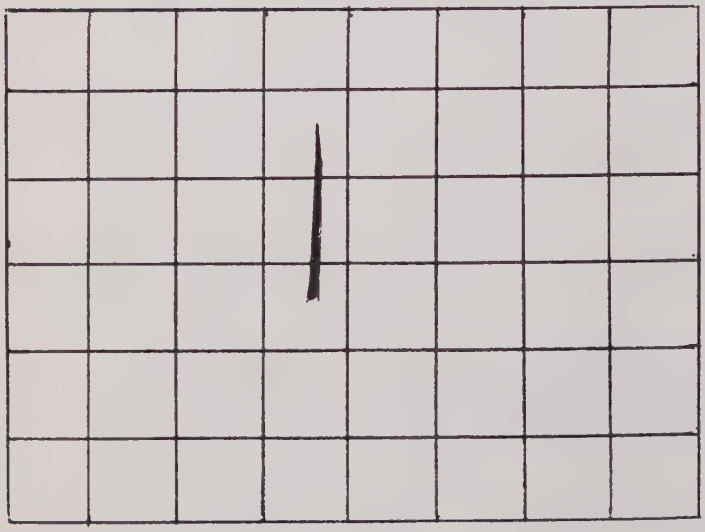
Problems



Check Q1, Q3, Q4, & Q11

Also R11 (470 ohm)

Bad Upper Half



Check Q2, Q5, Q6, & Q12

Also R27 (470 ohm)

Bad Lower Half

SAM IV SCOPE BOARDS

GENERAL TROUBLESHOOTING BE SURE TEST FIXTURE IS WORKING PROPERLY

1. Check for shorts.
2. Check that all resistors are the correct value.
3. Check that all capacitors are the correct value, and are in the right direction.
4. Check that all diodes, transistors and IC's are the correct type and installed properly.
5. Note which components (if any) heat up. This may help in locating the problem.

COMMON BLANKING BOARD PROBLEMS

1.	No Display	Adjust R89 (10K Intensity). Sometimes there will be no sweep until R89 is turned up.
2.	No Blanking	Be sure the large relay has energized.
3.	IC3 or 4 Explodes	Be sure the rectifying diodes (IN5624) are installed properly.

SAM IV UNIT CALIBRATION PROCEDURE

I Power Supplies

1) Check +6 VDC and +12 VDC power supplies. Should be ± .1 VDC.
    a. Changing the value of R116 will adjust the + VDC supply.

II 3rd L.O.

1) Must be in manual mode with no signal applied.
2) Connect a pick off loop to a frequency counter.
3) Sample the frequency of T1 and adjust if needed to have a frequency of 35.05 MHz with AFC on.
4) With AFC off adjust R73 for a frequency of 35.05 MHz.

III 2nd L.O

1) All new Sam I meters have a tuneable 2nd L.O. Some of the older units have a crystal controlled 2nd L.O.
2) For a 300 MHz unit the 2nd L.O. frequency should be 354.25 MHz.
3) For a 400 MHz or 450 MHz the 2nd L.O. frequency should be 414.25 MHz.
4) Connect a cable from a frequency counter to the "F" connector on the bottom of the R.F. assembly. This is located near the right hand corner of the R.F.

IV. R.F. Gain, Flatness, and Sweep Width

1) Connect an I.F. cable from an 1801 sweep generator preferabley, R.F. out port, to the I.F. in on the mainboard of the Sam.
    a. The generator should be set for an output of +20 dB at 45.75 MHz
    b. Connect a cable from the "demod in" to "video vert". on the front panel.
    c. Place the unit in open loop via S1 on the mainboard.
    d. Set the scope for an X-Y display with the horizontal out of the generator to the horizontal amp of the scope.
    e. Connect the vertical out to the generator to the vertical amp of the scope.
    f. Set the scope to .2 V per division, also DC coupled.
    g. Set the generator to 100 msec. sweep, with sweep time and sweep width for approximately 80 MHz.
    h. Adjust R7 (open loop gain) for a signal approximately 1 V.
2) Disconnect I.F. cable from the sweep generator and replace it with the I.F. cable form the R.F. assembly.
    a. Place the tuning board jack in the wide sweep position. This is one of the two jacks that is located on the tuning board that is closest to the wrap-around of the unit.
    b. Connect the R.F. out cable from the generator into the R.F. in connector on the Sam.
    c. Place the Sam attenuator to +20 dBmV-mid scale position.
    d. Tune the generator to 150 MHz at +20 dBmV.

e. Tune the Sam to 150 MHz in manual mode. Observe the signal.

f. Peak all tuning caps and coils on the R.F. assembly starting with the one at the left front of the R.F.

g. Tune the coil on the bottom of the R.F. for a peak signal. You should be observing an R.F. signal approximately 36 to 40 dBmV.

h. Adjust R7 again after this for a IV signal. This finishes R.F. gain check.

3) To check the flatness use your reference voltage of IV.

a. Start by tuning the Sam and the sweep generator together down in frequency. Watch the scope and observe the amplitude, it should not change more than ±.7 dBmV from 10 MHz to the top range of your meter.

b. Observe the sweep to also insure that the weep width goes down to -10 to -12 MHz and up past the top range of your meter plus about 12 MHz.

4) UHF Calibration

a. Check UHF Flattness by first switching the Sam into UHF. Connect the 1801 sweeper to the RF input of the Sam. Set a 1 V refference at 471 MHz, sweep up to 890 MHz. The signal cannot very more than +3 dB.

b. The flattness characteristics of the UHF L.O. are very different than that of the VHF L.O. therefore in some cases a UHF meter compensation resistor is needed. With the unit in closed loop peak up on a 150 MHz +20 dB signal from a MC50.

c. Use the calibration set pot to set the meter right at 20 dB. Remove the MC50 and connect the 1801 sweeper to the Sam.

d. With the 1801 in manual sweep to 150 MHz and set the variable attenuator of the 1801 so that the Sam meter reads exactly 20 dB. Switch the Sam into UHF and using the 1801 find the highest meter reading and the lowest meter reading between 471 MHz and 890 MHz. If these readings are within ±1.5 dB of the 20 dB refference, no compensation resistor is needed. If however the lowest UHF reading is not within 1.5 dB of 20 dB select a resistor of 1 M and place it in position R80. Repeat the a bove steps, being sure to reset the 150 MHz 20 dB reference. If the lowest UHF reading is still not within 1.5 dB of 20 dB, reduce the value of resistor R80. Make sure you check the highest UHF reading to see that it is not more than 1.5 dB greater than 20 dB. If you are unable to get the UHF readings within ±1.5 dB of 20 dB, the UHF L.O. board requires work and must be sent to the factory for repair.

V. AFC

1) Connect the Scope probe to IC9 pin 1, set the scop to IV pwe division.

2) Tune the Sam and 1801 sweeper to 150 MHz at +20 dBmV.
3) Tune MXI (discriminator coil) blue coil for a symmetrical signal, and adjust the pink coil for maximum amplitude-may need to adjust the blue coil again.

VI Integrator

1) Must be in closed loop. Connect scope probe to test point 1, pin 4 of IC3.
2) Set scope vertical to .5 V per division, and adjust vertical position until an inverted response appears.
3) Put in closed loop and place the sweeper in manual sweep mode. Sweep through from no signal to a maximum frequency signal. The maximum signal condition should lower the response by .4 V, adjust R31 for a .4 V difference.

VII. Meter Tracking

1) Set the +10 dB gain potentiometer to Cal. position and the cal set potentiometer to midrange.
2) R84 will be approximately a 220K ohm resistor.
3) Set the Sam attenuator to the +30 dBmV mid scale, and adjust R83 for a +20 dBmV reading on the left side of the meter movement.
4) Set the Sam attenuator to the +20 dBmV mid scale, and adjust R89 for a +20 dBmV reading on the left side of the meter movement.
5) Turn +10 dBmV potentiometer on the front panel all the way clockwise and adjust the Sam attenuator to +30 dBmV mid scale reading. Adjust R85 for a +30 dBmV reading.
6) Set the Sam attenuator to +40 dBmV mid scale reading and adjust R10 if necessary to make minor adjustment to low end. Go to the +20 dBmV attenuator setting at mid scale and check high end reading.

VIII. Peak Detector

1) R20 is selected to be approximately 22K to 39K ohm resistor.
2) Connect your MC-50 preferably (meter calibrator) out to the Sam R.F. in.
3) Tune your calibrator to 150 MHz at +20 dBmV.
4) Tune the Sam to 150 MHz and peak on the signal.
5) Turn on TV modulation, and the signal on the Sam should read +19.75 dBmV to +20 dBmV. If you do not have the reading in this window of range then change the value of R20.

IX. Hum

1) R 50 is selected for hum to be 27K +10K ohm resistor.
2) Connect your hum source.
3) Tune the Sam to the frequency of the source.
4) Swith to hum. The needle will peg momentarily. The hum will read within ±.3% of your hum source. The low level will read less than .5%, the next level will be 2% ±.25%,and the last level will be 4% ±.25%. Adjust R51 as needed to achieve these levels.

X. Analyzer

1) CR1 and R24 are selected for the analyzer circuit CR1 is a IN914 diode, and R24 is typically between a 18K to 24K ohm resistor.
2) Adjust your scope for X-Y display, plug cable from the Sam horizontal to scope horizontal.
3) Connect the video vertical on the Sam to the vertical on the scope.
4) Set the scope to .5V per didision.
5) Set the Sam function switch to analyzer and manual/sweep switch to sweep.
6) Set the sweep rate fully clockwise and dispersion fully clockwise on the Sam.
7) Adjust R25 for the noise level of .4 V to .6 V.
8) a. Adjust R39 (DC level) potentiometer for the lower peaks to be cut off.
   b. For Sam IIID's models, do not adjust R39 for the DC level. Adjust R146, (2M potentimeter added to the bottom of the mainboard), so the lower peaks are cut off.
      NOTE: R39 is used to adjust data used for remote operation. Refer to the processor board and LCD board Test at Systems Level, Section 5 of diagnostic test.
9) Using your dispersion control should allow you to see 0 MHz to the top frequency your particular meter is speced for.
10) All spurs should be at least 20 dB down from your reference signal at +20 dB.

XI. S/N

1) Tune Sam to your calibrated frequency (ours is at 63 MHz) to achieve a peak reading. Select R21 typically an 80K (±20 K) ohm resistor for a S/N reading after depressing switch to be ±1 dB from your standard.

XII. Video

1) Connect the video signal to the RF in on the Sam.
2) Connect the video vert on the Sam to the vertical on the scope at .1 V per division.
3) Adjust R27 for 85% scope reading on the video portion of the signal.
4) This signal should be .1 V out of DC level and be .7 cm high with the peaks touching .1 V and .8 V respectively.

XII. Spurs

1) Turn the +10 dB gain potentiometer on the front panel all the way clockwise and set the attenuator to the lowest scale (-20dB).
2) Tune the Sam from 4.0 MHz to the highest frequency of your meter, you shouldn't see any meter deflection.

XIV. Voltmeter

1) Place function switch to the voltmeter postion.
2) Connect AC and DC voltage, they should be ±3%.

XV. Frequency Accuracy

1) Place the Sam PGM/MAN switch to PGM. Tune to 150.0 MHz using the keyboard. Set the attenuator at +15 thru +25 scale. Connect an MC50 (set to 150.0 MHz at +20 dBmV) to the RF input of the Sam. With AFC off, the signal should read +20 dBmV on the Sam. If not adjust T1 on the mainboard until the meter peaks. With AFC on, the needle should not move at all. If you try to repeak the Sam using the fine tune adjust on the MC50, the frequency should not move more than ±.03 MHz. If the unit changes more than this, turn AFC off and peak the MC50 at 150.0 MHz. The meter should read +20 dBmV. Turn AFC on and peak the RF.

XVI CHARGING CIRCUIT

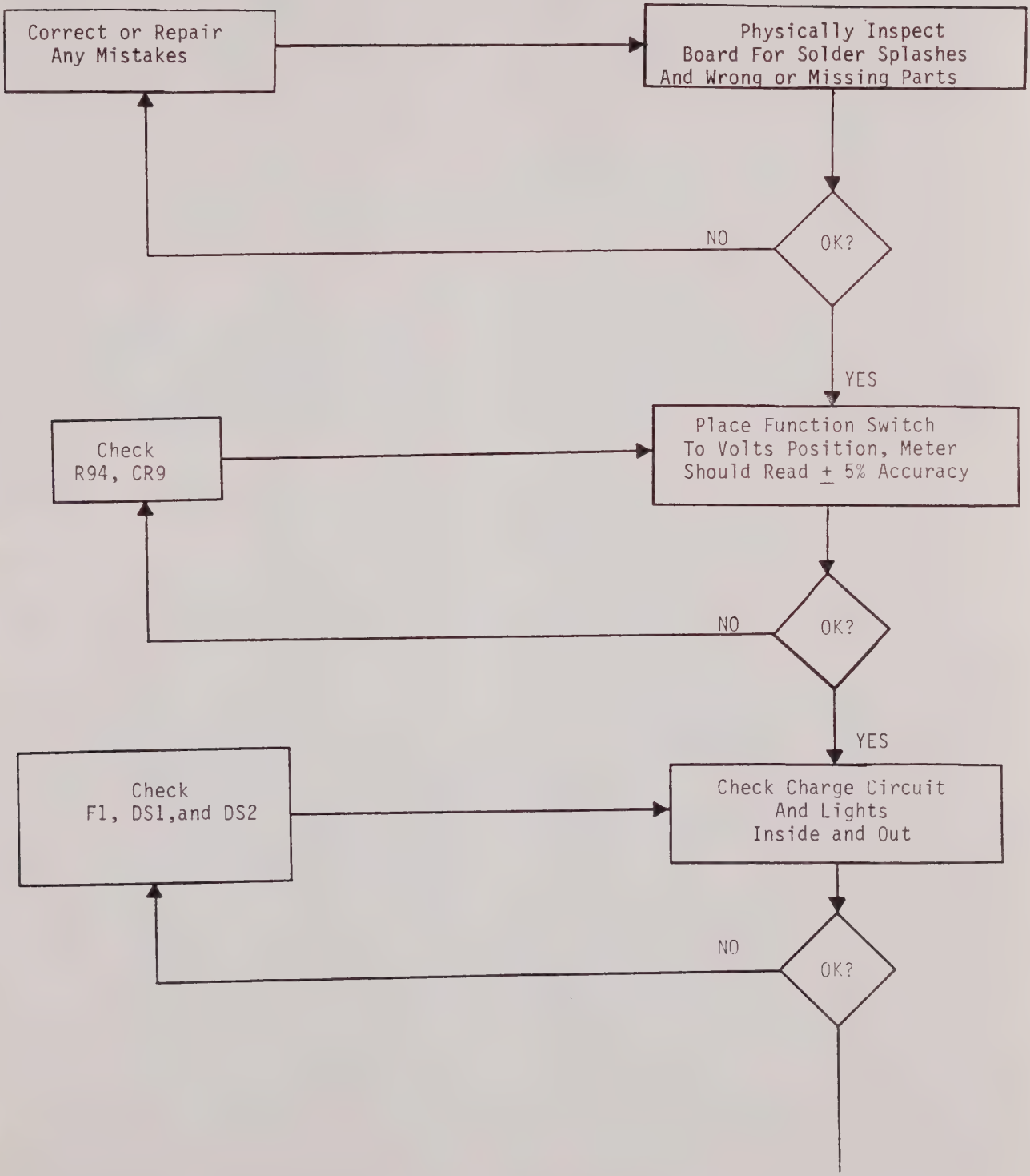
1. With the Sam connected to an external power supply, it will consume approximately 300 mA, this wi with the light switch on and the volume turned fully on
2. Plug in the AC charge plug to the Sam, observe the power supply-the current should drop to approximately 150 mA. At this time both the inside charge light and the front panel charge light should be eluminating.

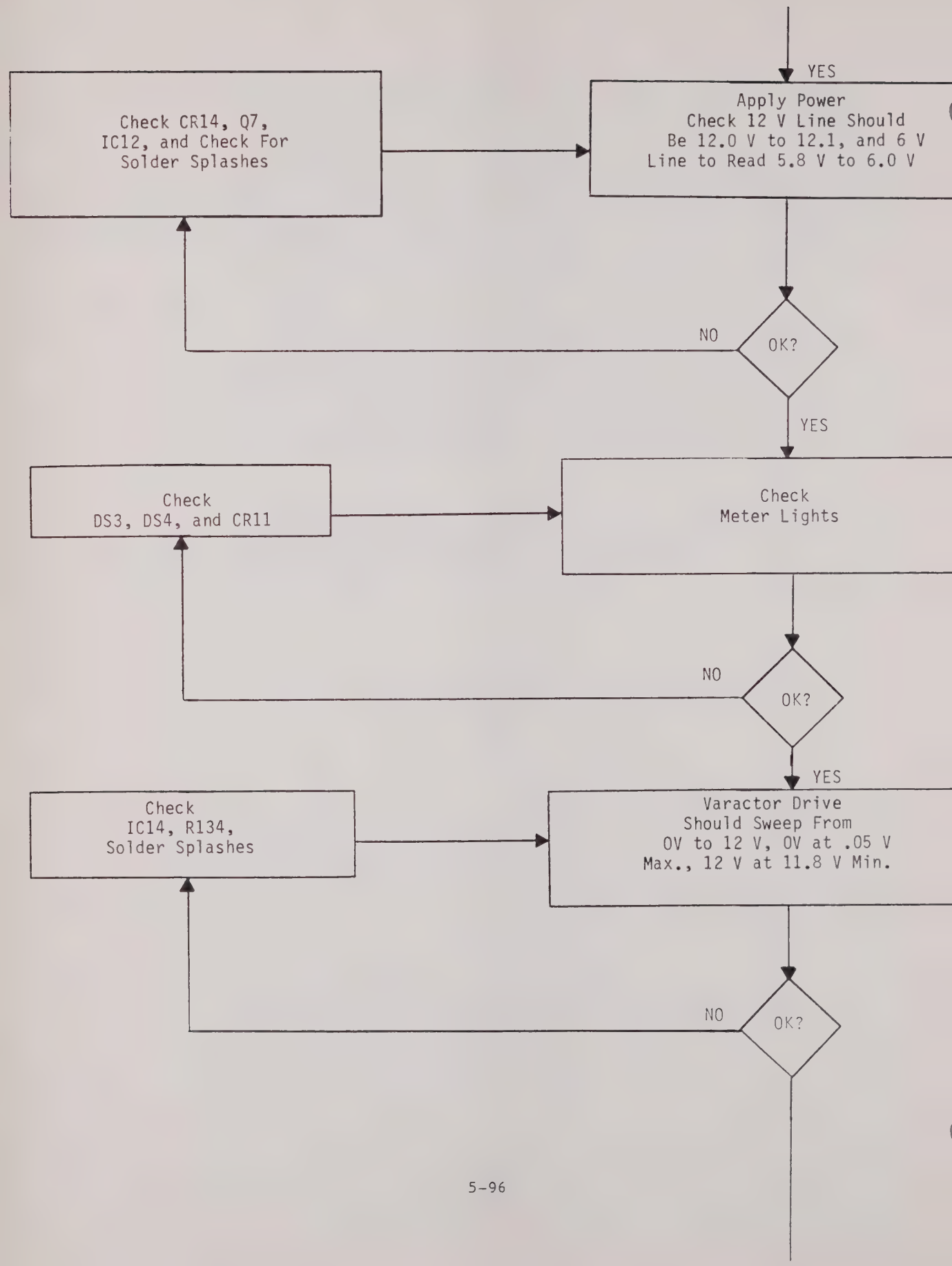
XVII. Calibrator

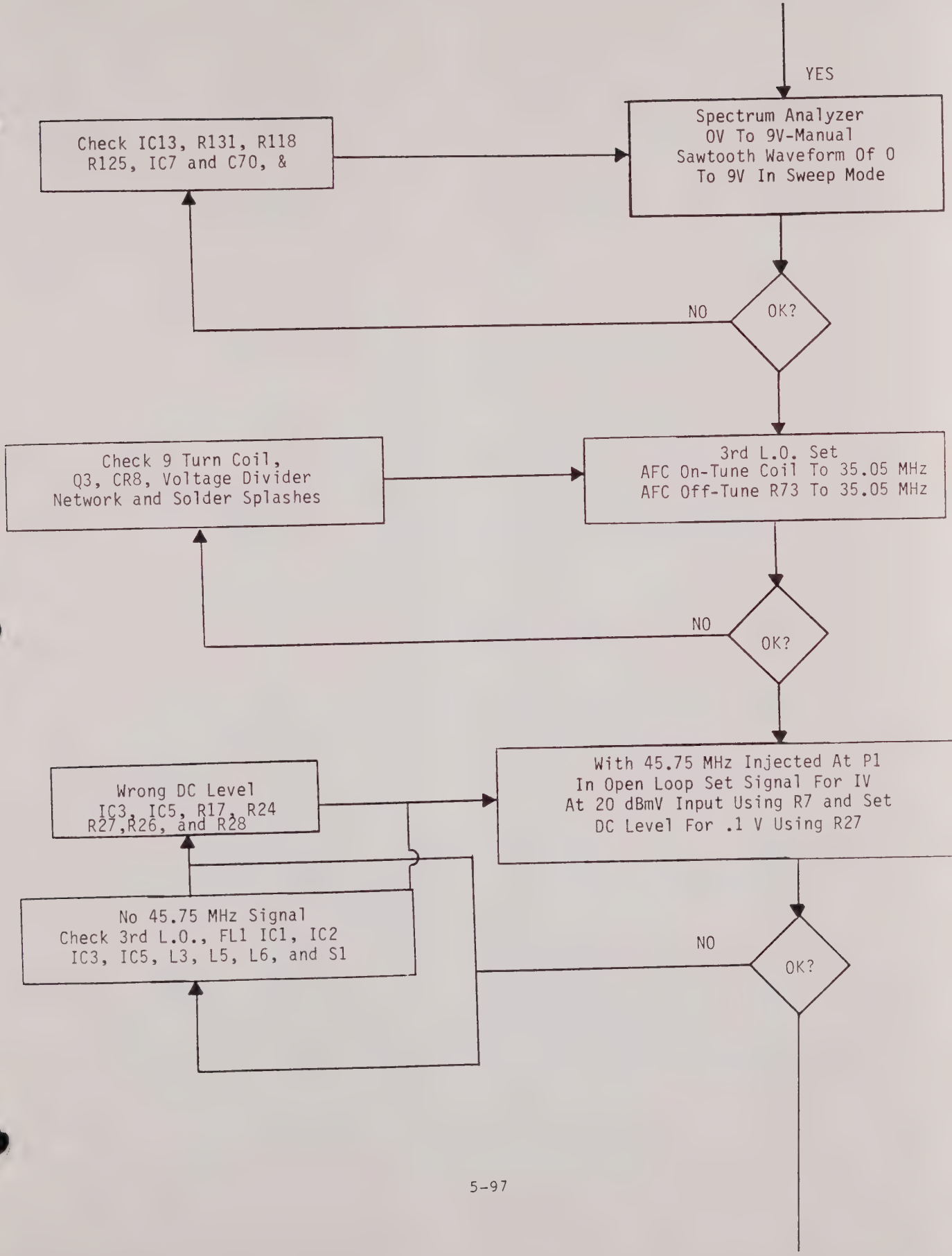
1) Connect a cable from a frequency counter to the calibrator out on the Sam.
2) Adjust L11 on the Sam mainboard for 150 MHz ±.1 MHz.
3) Adjust R102 for +20 dBmV on the meter.

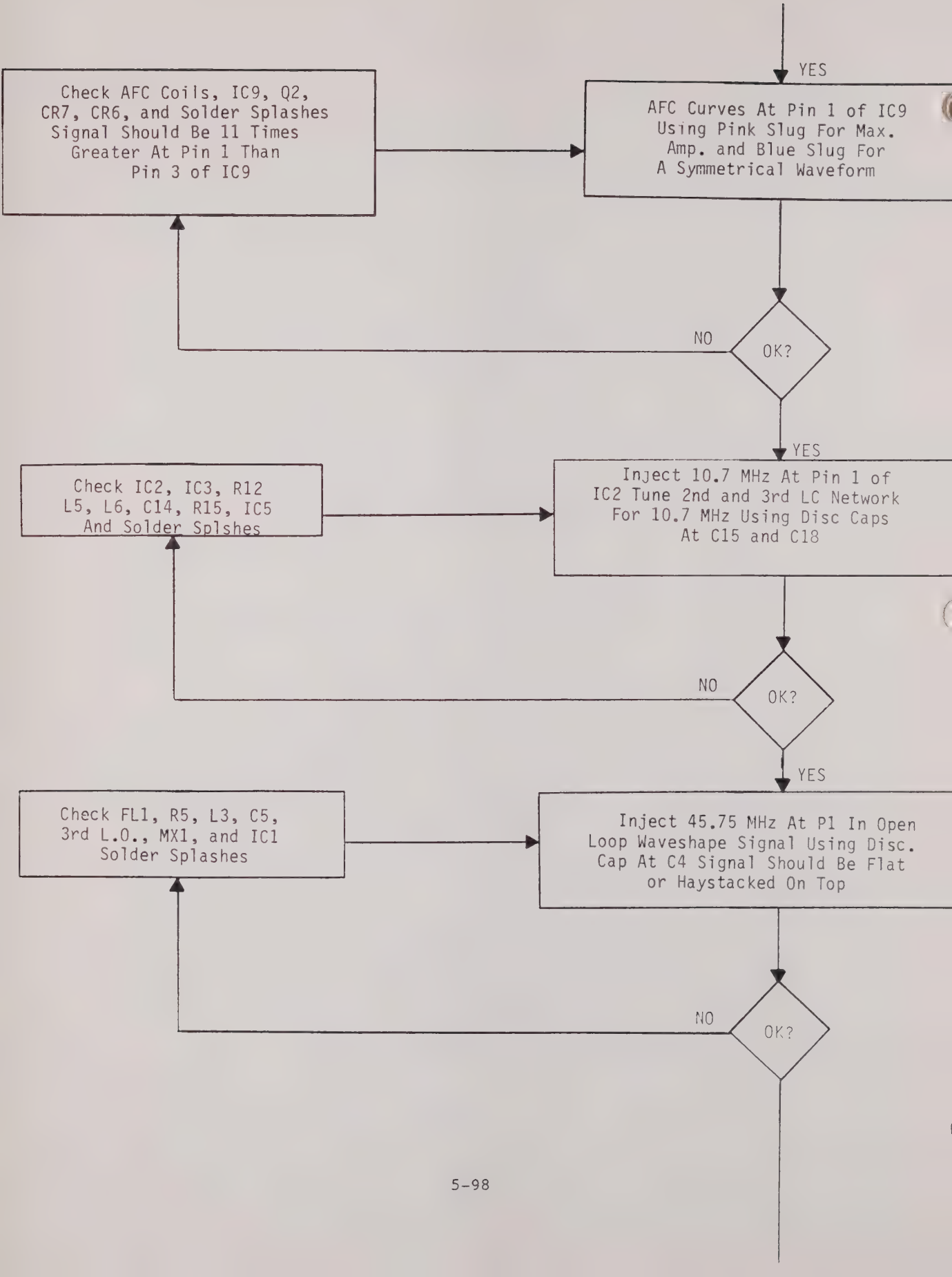
SAM MAIN BOARD

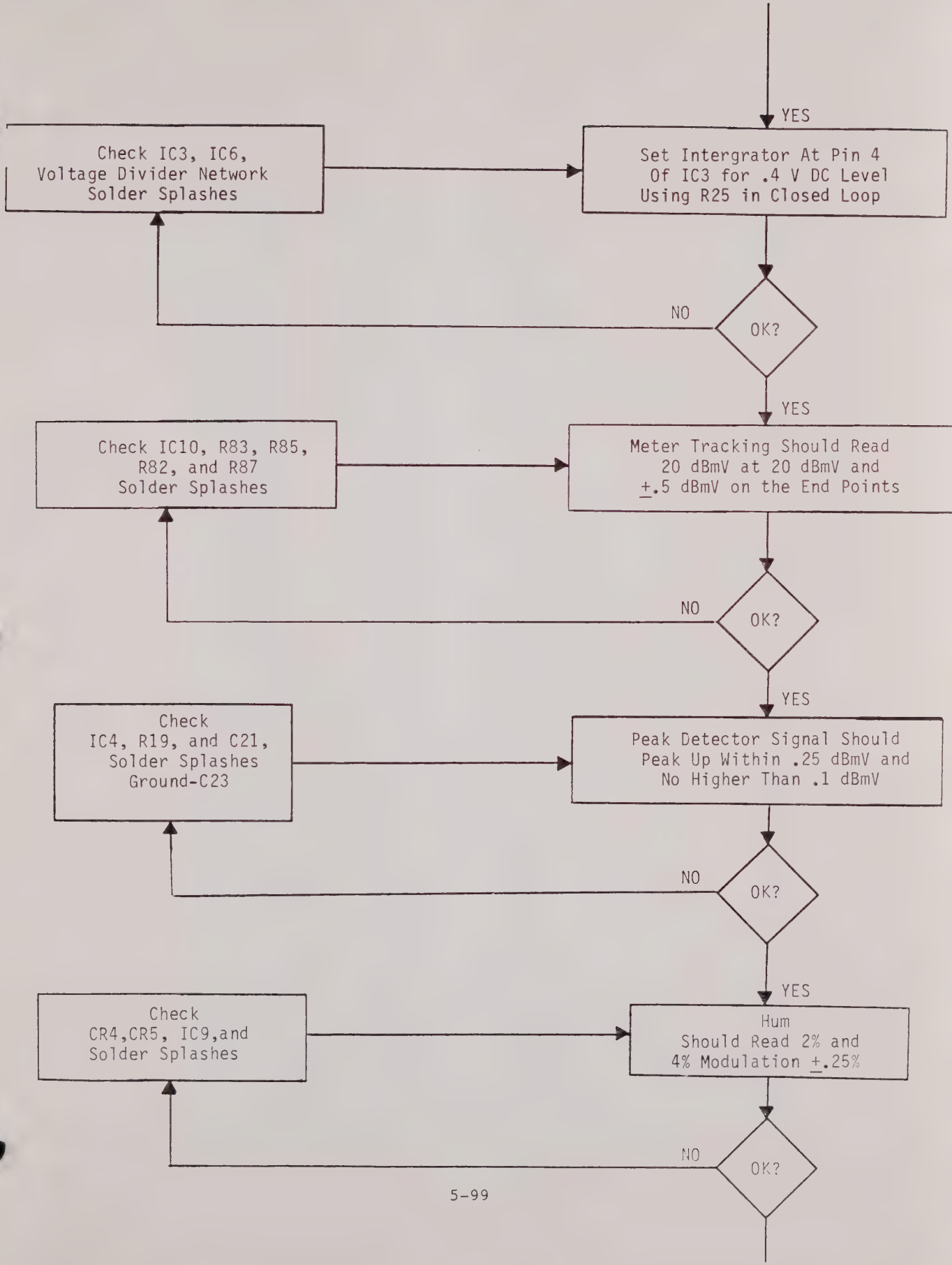
(Troubleshooting)

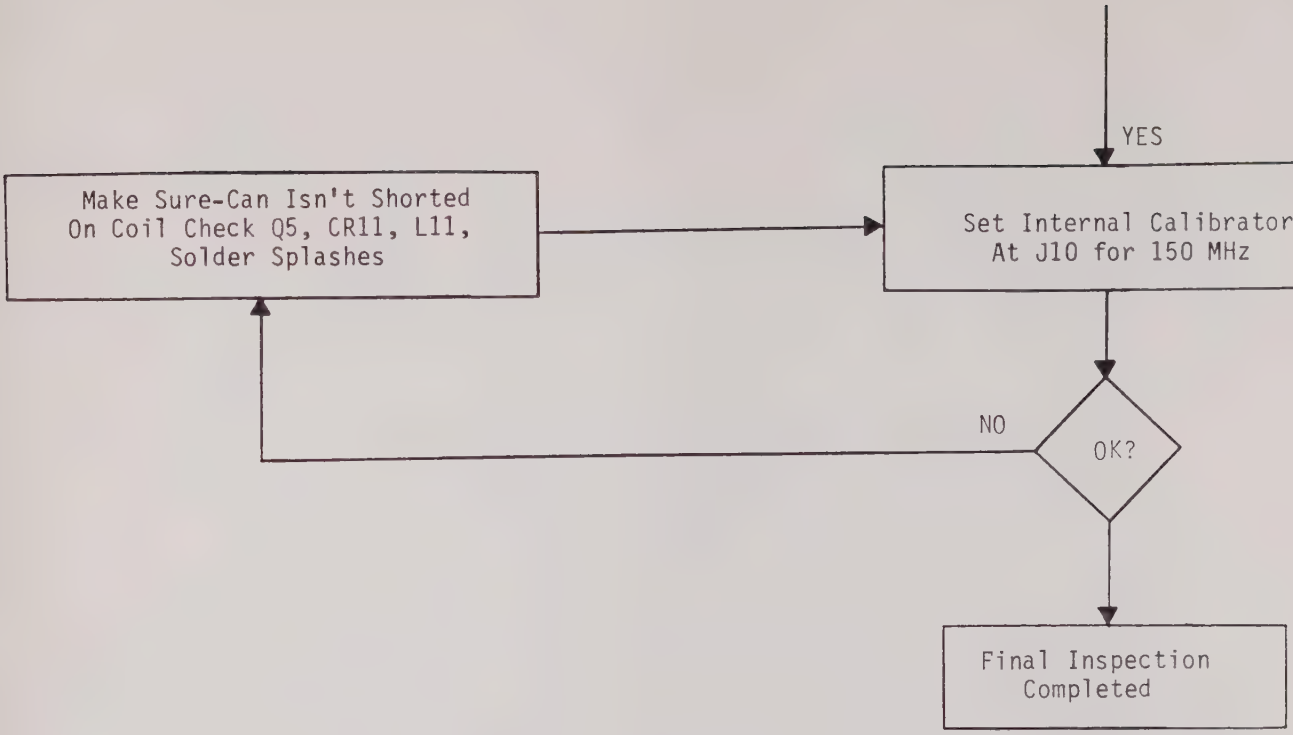



YES
Apply Power
Check 12 V Line Should
Be 12.0 V to 12.1, and 6 V
Line to Read 5.8 V to 6.0 V
Check CR14, Q7,
IC12, and Check For
Solder Splashes
NO
OK?
YES
Check
Meter Lights
Check
DS3, DS4, and CR11
NO
OK?
YES
Varactor Drive
Should Sweep From
0V to 12 V, 0V at .05 V
Max., 12 V at 11.8 V Min.
Check
IC14, R134,
Solder Splashes
NO
OK?


YES
Spectrum Analyzer
OV To 9V-Manual
Sawtooth Waveform Of 0
To 9V In Sweep Mode
Check IC13, R131, R118
R125, IC7 and C70, &
NO
OK?
3rd L.O. Set
AFC On-Tune Coil To 35.05 MHz
AFC Off-Tune R73 To 35.05 MHz
Check 9 Turn Coil,
Q3, CR8, Voltage Divider
Network and Solder Splashes
NO
OK?
With 45.75 MHz Injected At P1
In Open Loop Set Signal For IV
At 20 dBmV Input Using R7 and Set
DC Level For .1 V Using R27
Wrong DC Level
IC3, IC5, R17, R24
R27,R26, and R28
No 45.75 MHz Signal
Check 3rd L.O., FL1 IC1, IC2
IC3, IC5, L3, L5, L6, and S1
NO
OK?


YES
AFC Curves At Pin 1 of IC9 Using Pink Slug For Max. Amp. and Blue Slug For A Symmetrical Waveform
Check AFC Coils, IC9, Q2, CR7, CR6, and Solder Splashes Signal Should Be 11 Times Greater At Pin 1 Than Pin 3 of IC9
NO
OK?
YES
Inject 10.7 MHz At Pin 1 of IC2 Tune 2nd and 3rd LC Network For 10.7 MHz Using Disc Caps At C15 and C18
Check IC2, IC3, R12 L5, L6, C14, R15, IC5 And Solder Splshes
NO
OK?
YES
Inject 45.75 MHz At P1 In Open Loop Waveshape Signal Using Disc. Cap At C4 Signal Should Be Flat or Haystacked On Top
Check FL1, R5, L3, C5, 3rd L.O., MX1, and IC1 Solder Splashes
NO
OK?


YES
Set Intergrator At Pin 4
Of IC3 for .4 V DC Level
Using R25 in Closed Loop
OK?
NO
Check IC3, IC6,
Voltage Divider Network
Solder Splashes
YES
Meter Tracking Should Read
20 dBmV at 20 dBmV and
±.5 dBmV on the End Points
OK?
NO
Check IC10, R83, R85,
R82, and R87
Solder Splashes
YES
Peak Detector Signal Should
Peak Up Within .25 dBmV and
No Higher Than .1 dBmV
OK?
NO
Check
IC4, R19, and C21,
Solder Splashes
Ground-C23
YES
Hum
Should Read 2% and
4% Modulation ±.25%
OK?
NO
Check
CR4,CR5, IC9,and
Solder Splashes


YES
Make Sure-Can Isn't Shorted
On Coil Check Q5, CR11, L11,
Solder Splashes
Set Internal Calibrator
At J10 for 150 MHz
NO
OK?
Final Inspection
Completed

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
0012-10-9011	ASY DWG, LCD BOARD	1.000
0012-20-9004	ASSY DWG, PROC BD	1.000
0014-20-9002	SCH, LCD BOARD	1.000
0014-30-9005	SCH, PROCESSOR BD	1.000
0016-00-9016	TEST PROC, PROC PC BD	1.000
0016-00-9017	TEST PROC, LCD BD	1.000
0412-00-9018	ASY DWG, VHF OSC PCB	1.000
0412-00-9019	ASY DWG, UHF OSC PCB	1.000
0412-00-9020	MOD. INSTRUCTION	1.000
0412-10-9025	ASY DWG, PRESCALER BD	1.000
0412-20-0001	AY DWG, ATTEN BRT ASY	1.000
0412-20-0002	AY DWG, SIDE MT ASSY	1.000
0412-30-0003	ASY DWG, V/H AMP BD	1.000
0413-00-9016	PROGRAM: 8410-00-0041	2.000
0414-10-9013	SCH, PRESCALER PCB	1.000
0414-10-9014	SCH, UHF OSC PCB	1.000
0414-10-9015	SCH, VHF OSC PCB	1.000
0414-30-0028	SCH, RF CONVERTER	1.000
0417-00-9001	PERFORMANCE SPEC	1.000
0417-00-9002	PERFORMANCE SPEC,	1.000
0417-00-9021	PERFORMANCE SPEC,	1.000
0417-00-9022	PERFORMANCE SPEC	1.000
0417-00-9023	PERFORMANCE SPEC	1.000
1110-00-0410	METER BD, SAM I & II	1.000
1110-40-0001	PC ASSY, LCD BD-III	1.000
1110-40-0002	SAM IV, P/S BLANKING	1.000
1110-40-0003	SAM IV, V/H AMP BD	1.000
1110-40-0010	FINAL ASY, SAM IV-UHF	1.000
1110-40-0022	MAIN BD, SAM IV	1.000
1110-40-9018	PC ASY, PROCESSOR, UHF	1.000
1113-20-0051	ATTEN, 7570-06	1.000
1118-10-2013	ROTOR ASSY, 7570	1.000
1118-10-2106	F PLATE AY, 7570-05	1.000
1118-10-2228	ENCL ASSY, 7570-06	1.000
1118-10-2403	CONN KIT	1.000
1118-40-0011	SAM IV FP ASSY	1.000
1118-40-0012	SAM IV FP PARTS KIT	1.000
1118-40-0015	SAM IV, FINAL ASSY	1.000
1118-40-0016	SAM IV, SCOPE FP ASSY	1.000
1118-40-0017	CHAS MT SAM DC BLOCK	1.000
1210-32-0019	COIL, 4T	1.000
1210-42-0050	RF XFMR	1.000
1210-43-0007	COIL, 19T, 24GA	1.000
1210-43-0008	RF XFMR	1.000
1216-00-0018	CHASSIS, RF, SAM III	1.000
1216-40-0003	SAM IV SIDE MT ASSY	1.000
1216-40-0004	SAM IV ATTEN BRT ASY	1.000
1217-70-0008	CABLE ASSY, 5-1/4 IN	1.000
1217-70-0070	CABLE ASSY, 7 1/2IN	1.000
1217-70-0071	CABLE ASSY, 6IN	1.000
1217-70-0092	CABLE ASSY, 21-1/2 IN	1.000
1217-70-0093	CABLE ASSY, 21-1/2 IN	1.000
1218-40-0002	PRELIM LCD PC BD	1.000
1218-40-0003	PRELIM PCB, SAM PROC	1.000
1218-40-0005	SAM IV, HV BD SUB ASY	1.000
1218-40-0006	SAM IV LED PCB	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1218-40-0007	SAM IV,SC CONTROL BD	1.000
1218-40-0008	SAM IV,HV BD T UP	1.000
1218-40-0009	SAM IV,P/S BLANKING	1.000
1218-40-0010	SAM IV,V/H AMP BD	1.000
1218-40-0015	MAIN BD PRELIM,SAM I	1.000
1218-40-9017	PC ASSY,PRESCALER	1.000
1218-40-9018	PC ASSY,OSC,VHF	1.000
1218-40-9019	PC ASSY,OSC,UHF	1.000
1219-00-0226	HARNESS,SAM III RF	1.000
1219-00-0280	RF SUBAY O,	1.000
1219-00-9005	HARNESS, KEYBD/LCD	1.000
1219-00-9007	HARNESS, TEMP SENSOR	1.000
1219-40-0003	LCD BD FINAL KIT	1.000
1219-40-0004	HARNESS, LCD/PROC	1.000
1219-40-0005	HARN,PWR SW MB	1.000
1219-40-0008	PROC BD FINAL KIT	1.000
1219-40-0009	COIL KIT,SAM MAIN BD	1.000
1219-40-0010	HARNESS,SAMJR UHF RF	1.000
1219-40-0012	CABLE,RS-232,5 COND	1.000
1219-40-0015	HARNESS,SAM IV H/S	1.000
1219-40-0017	SAM IV SCOPE HARNESS	1.000
1219-40-0018	SAM IV,WRAPAROUND	1.000
1219-40-0019	SAM IV,H/S ASSY	1.000
1219-40-0020	SAM IV,PW SW HARNESS	1.000
1219-40-0021	SAM IV,POT BD HRNS	1.000
1219-40-0022	SAM IV SCOPE HRNS KT	1.000
1219-40-0023	SAM IV,HV FINAL	1.000
1219-40-0024	SAM IV,RS232 HARNESS	1.000
1219-40-0025	SAM IV,POWER BD	1.000
1219-40-0026	SAM IV SHIPPING KIT	1.000
1219-40-0038	CABLE,ATTENUATOR KIT	1.000
1219-40-0051	HARN,SAM IV V/H AMP	1.000
1219-40-0070	RF SUBAY 3-4	1.000
1219-40-0071	RF SUBAY 5-6	1.000
1219-40-0072	MAIN BD FINAL PARTS	1.000
1219-40-0075	OPT KIT,SAM IV-UHF	1.000
1219-40-9026	HARNESS,OPT SWITCH/	1.000
1219-40-9027	RF SUBAY 1-2	1.000
1410-00-3550	HEAT SINK	1.000
1410-00-5020	FOAM TAPE PER B/P	4.000
1410-01-1670	TRANSISTOR MTG. BRKT	1.000
1410-01-1960	SPEAKER GRILL 2 X 2	1.000
1410-01-1980	HUDSON CAN HU-5566	1.000
1410-01-2000	ROD, 8 7/8"X1/4" DIA	1.000
1410-01-2010	DRUM, TAPPED,	2.000
1410-01-2030	GEAR, TAPPED,	2.000
1410-01-2040	SAM CLEAR PLEXIGLASS	1.000
1410-01-2730	PWR SHEILD	1.000
1410-30-2210	SAM SPEAKER BRACKET	1.000
1410-30-2220	SAM RF LID COVER PER	1.000
1410-30-2240	SAM RIGHT ANGLE B/P	1.000
1410-80-0750	SAM RF METAL WORK	1.000
1411-00-0160	FOLLOWER CAM	1.000
1411-00-0270	SHAFT ADAPT.PER B/P	1.000
1411-00-0410	SHAFT	1.000
1411-00-0430	COUPLING PER B/P	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1411-00-0450	PLATE,REAR	1.000
1411-00-0520	COUPLING	1.000
1411-00-0530	COUPLING	1.000
1411-00-0550	CONTACT PLATE	2.000
1411-00-0670	MOLD PLAS. ROTOR B/P	2.000
1411-00-1110	CONTACT	20.000
1411-00-1130	CONDUCTOR	1.000
1411-00-1820	WIPER CONTACT	2.000
1411-00-2080	BALL BEARING	2.000
1411-00-2090	DETENT SPRING	4.000
1411-00-2160	ENCLOSURE	1.000
1411-00-6260	SPACER PER B/P	1.000
1411-11-2820	COVER/STOP PL,	1.000
1411-11-2830	SHAFT,DETENT,PER B/P	1.000
1411-11-3560	FINGER CONTACT STRIP PER B/P	2.000
1411-11-3570	PLATE FRONT	1.000
1411-11-3615	DETENT SHAFT PER B/P	1.000
1414-00-1002	COPPER TAPE 1610-02-0002	2.000
1414-00-1003	BUSHING,	1.000
1414-00-1009	SAM IV S CO MTG BRKT	1.000
1414-00-1010	CHAS MT DC BLOCK	1.000
1414-00-1011	KNOB,DUAL CONCENTRIC PER B/P	1.000
1414-00-1015	BRACKET, METER	1.000
1414-00-9062	MTG PLATE, "PER B/P"	1.000
1414-00-9065	BRKT,MTG,UHF OSC PCB	1.000
1414-30-1002	SAM IV,FACE PLATE II	1.000
1414-30-1003	HEAT SINK SAM IV	1.000
1414-30-1004	SAM IV BRACKET	1.000
1414-60-1005	SAM IV ATTEN BRACKET	1.000
1414-60-1006	SAM IV TOP COVER	1.000
1414-60-1007	SAM IV BOTTOM COVER	1.000
1414-60-1008	SAM IV 4V SHIELD	1.000
1414-60-1009	SAM IV SIDE PLATE	1.000
1414-60-1010	SAM IV DIVIDER	1.000
1414-80-1003	SAM IV FRONT PANEL	1.000
1414-80-1005	SAM IV WRAPAROUND	1.000
1510-00-1102	CAP,CHIP,1000PF,50V	18.000
1510-00-2750	CAP.,CHIP 75PF 10%	2.000
1510-00-3104	CAP.,CHIP,.1 MF	3.000
1510-00-5470	CAP,CHIP,47PF	3.000
1510-00-9102	CAP,CHIP,1000	6.000
1510-10-0100	CAP,DISC,1KV,10PF	3.000
1510-10-0101	CAP,DISC,1KV,100PF	2.000
1510-10-0120	CAP,DISC,1KV,12PF	1.000
1510-10-0121	CAP,DISC,1KV,120PF	1.000
1510-10-0150	CAP,DISC,1KV,15PF	2.000
1510-10-0200	CAP,DISC,1KV,20PF	3.000
1510-10-0202	CAP,DISC,1KV,2PF	2.000
1510-10-0309	CAP,DISC,1KV,3PF	1.000
1510-10-0330	CAP,DISC,1KV,33PF	1.000
1510-10-0500	CAP,DISC,1KV,50PF	5.000
1510-10-0609	CAP,DISC,1KV,6PF	1.000
1510-10-0689	CAP,DISC,1KV,6.8PF	1.000
1510-10-0750	CAP,DISC,1KV,75PF	5.000
1510-10-1102	CAP,DISC,1KV,.001UF	1.000
1510-10-1103	CAP,DISC,1KV,.01UF	4.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1510-10-1302	CAP,DISC,1KV,.003UF	1.000
1510-10-1471	CAP,DISC,1KV,470PF	1.000
1510-10-2104	CAP,DISC,100V,.1UF	2.000
1510-10-2503	CAP,DISC,100V,.05UF	2.000
1510-10-6561	CAP,DISC,6KV,560PF	4.000
1510-10-7471	CAP,DISC,50V,470PF	4.000
1510-11-1154	CAP,DISC,100V,.15UF	12.000
1510-11-3105	CAP,MON,50V,1UF	3.000
1510-12-0102	CAP,DISC,1000PF	1.000
1510-12-1102	CAP,DISC,1000PF	14.000
1510-12-2103	CAP,DISC,80/20,.01MF	4.000
1510-12-2104	CAP,DISC,80/20,.1MF	13.000
1510-12-2224	CAP,DISC,Z12V,.22MF	2.000
1510-12-3331	CAP,DISC,330	3.000
1510-14-4103	CAP,MON,50V,.01UF	1.000
1510-20-4101	CAP,ELEC,25V,100UF	3.000
1510-20-5100	CAP,ELEC,50V,10UF	1.000
1510-20-5500	CAP,ELEC,50V,50UF	1.000
1510-20-6200	CAP,ELEC,250V,20UF	2.000
1510-21-3250	CAP,ELEC,100V,25UF	1.000
1510-21-7100	CAP,TANT,25V,10UF	4.000
1510-23-1472	CAP,ELECT,35V,4700UF	4.000
1510-23-4101	CAP,ELEC,25V,100UF	4.000
1510-23-5221	CAP,ELEC,16V,220UF	1.000
1510-23-7150	CAP,ELEC,25V,15UF	1.000
1510-23-9222	CAP,ELEC,16V,2200UF	1.000
1510-24-0229	CAP,TANT,25V,2.2UF	7.000
1510-25-1102	CAP,ELEC,50V,1000UF	1.000
1510-26-2331	CAP,TANT,6.3V,330UF	3.000
1510-31-8501	CAP,FT,500PF	13.000
1510-31-8759	CAP,FT,500V,7.5PF	1.000
1510-40-0139	CAP,COMP,500V,1.3PF	1.000
1510-40-1019	CAP,COMP,500V,.1PF	1.000
1510-40-1119	CAP,COMP,500V,1.1PF	2.000
1510-40-1228	CAP,COMP,500V,.22PF	1.000
1510-40-1279	CAP,COMP,500V,2.7PF	1.000
1510-50-6102	CAP,MICA,100V,1000PF	1.000
1510-60-0104	CAP,MYLR,200V..1UF	1.000
1510-60-0224	CAP,MYLR,200V,.22UF	1.000
1510-60-2154	CAP,MYLR,100V,.15UF	1.000
1510-61-8474	CAP,MYLR,100V,.47UF	1.000
1510-61-9338	CAP,MYLR,200V,.33PF	1.000
1510-70-1030	CAP,VAR,.5-3PF	1.000
1510-71-2859	CAP,VAR,.8-8.5PF	2.000
1510-71-3100	CAP,VAR,10PF	3.000
1610-02-0002	TAPE,COPPER,1/4", (18YDS.PER RL)	3.680
1710-00-2350	PC BOARD, 080-044F FROM:3210-05-0052	1.000
1710-00-2900	DS PC BOARD,ZZ1015	1.000
1710-00-2910	DS PC BOARD,ZZ1016	1.000
1710-00-3510	PC BD Z564	1.000
1710-00-3530	PC BOARD Z566A	1.000
1710-00-3800	PC BOARD, 080-045C FROM:3210-05-0044	1.000
1710-00-5053	SAM IV LED BD	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1710-00-5054	SAM IV PS BLNK PCB	1.000
1710-00-5056	DS PC BOARD, ZZ706	1.000
1714-00-0000	SAM IST L.O. PCB	2.000
	FROM: 3210-05-0046	
1714-00-0004	PCB, SAM III SHIELD	1.000
1714-00-9017	PCB, PRESCALER	1.000
1810-01-5100	CHOKE, MOLDED, 510UH	2.000
1810-06-0002	COIL, 110 T	1.000
1810-06-0003	COIL, TAPPED, 1:1-1/2	2.000
1810-06-0004	COIL, TAPPED, 1:4	1.000
1810-10-0189	CHOKE, MOLDED, 1.8 UH	9.000
1810-10-0220	CHOKE, MOLDED, 22 UH	7.000
1810-10-0560	CHOKE, MOLDED, 56 UH	2.000
1811-04-0001	DISCRIMINATOR COIL	1.000
1812-00-0005	YOKE, 7 IN CRT	1.000
1813-00-0007	FERR. BEAD, LC000-009	12.000
1813-00-0033	COIL FORM	2.000
1813-00-0036	SLUG CORE	2.000
1813-00-0038	COIL MNTG. BASE	2.000
1813-00-0039	COILFORM	2.000
1813-00-0052	FERRITE SLEEVE	1.000
1813-00-0053	BALUN CORE	2.000
1815-00-0017	COIL, 4-1/2T, #22	1.000
1815-00-0099	COIL, AIR,	1.000
2110-00-0001	ADPTR, F-F/F-F, 1.13	4.000
2110-01-1001	CONN, BNC-F, 75, FLANGE	2.000
2110-01-1002	CONN, BNC-F, 75, FLANGE	2.000
2110-06-0001	CONN., F	4.000
2110-06-0004	ADPTR, F-F/F-F, .80	1.000
2110-06-1005	CONN, F, W/HDWR	5.000
2110-06-1006	CONN JV000-005	2.000
2111-00-0006	NUT, 1/2-20X1/16TH	2.000
2111-05-0008	LWSHR, INT, 1/2 ID	1.000
2112-00-0007	IC SKT, 8 PIN	3.000
2112-00-0011	IC SKT, PC, 14 PIN	10.000
2112-00-0012	IC SKT, 16 PIN	17.000
2112-00-0013	IC SKT, PC, 24 PIN	6.000
2112-00-0014	CRT SKT, MC000-061	1.000
2112-00-0021	IC SOCKET, 40-PIN	1.000
2112-00-0022	IC SOCKET, 18-PIN	1.000
2112-00-0023	IC, SKT, 28-PIN	1.000
2112-00-0029	SOCKET, STRIP, 20 PIN	2.000
2112-01-0005	JACK, BANANA, RD	1.000
2112-01-0006	JACK, BANANA, BK	1.000
2112-02-0001	LEAD ASSY, H.V.	1.000
2112-03-0003	GROUND LUG, #6, INT	1.000
2112-03-0009	GROUND, LUG #6	1.000
2112-03-0024	TERM, LCKNG, 3/8IN	3.000
2112-03-0025	TERM, LCKNG, NO 10	2.000
2112-03-0026	SOLDER LUG	1.000
2112-04-0004	CONNECTOR	2.000
2112-04-0005	CONNECTOR	1.000
2112-05-0003	CONN, 15-PIN, KONEKTON	2.000
2112-05-0004	PLUG, LOCKING	1.000
2112-05-0006	CONN., MALE 5-PIN	1.000
2112-05-0007	7-PIN LOCKING PLUG	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
2112-05-0008	PLUG, 3-CKT	2.000
2112-05-0010	CONN., MALE, 2-PIN	2.000
2112-06-0004	PLUG, RA, 11-PIN	1.000
2112-06-0005	PLUG, RA, 15-PIN	1.000
2112-07-0000	HEADER, 36-PIN, STRT.	2.076
2112-07-0001	HEADER, 3-PIN STRT	5.000
2112-07-0003	HEADER, 10-PIN STRT	3.000
2112-07-0006	HEADER, 8-PIN STRT	1.000
2112-07-0007	HEADER, STRT, 2 PIM	1.000
2112-07-0008	HEADER, 6-PIN, STR.	2.000
2112-07-0020	HEADER, 1-PIN, STRT	2.000
2112-07-0025	CONN., MALE, 10-PIN	1.000
2112-10-0002	PV JUMPER	9.000
2112-12-0005	PHONO JACK	1.000
2112-12-0006	PLUG, PHONO, LONG	1.000
2112-16-0011	CARD GUIDE, 4 IN	2.000
2112-19-0002	STANDOFF, HT115-000	5.000
2112-19-0003	GRIPLET-FUNNEL, .070	11.000
2112-35-0001	CONN, PC MOUNT, 5 CKT	1.000
2112-35-0002	CONN, PC, 20-PIN	1.000
2112-36-0001	SOCKET, RIBBON CABLE,	1.000
2113-03-0003	RECEPTACLE	1.000
2113-04-0003	PLUG	1.000
2113-04-0006	PLUG, MIN, 3-PIN	1.000
2113-05-0002	TERM MALE, MC000-019	1.000
2113-05-0003	CONTACT, MC000-041	2.000
2113-06-0003	CONN, 15-PIN, KONEKTON	3.000
2113-06-0005	CONN, 12-CIRCUIT	1.000
2113-06-0006	CONN, MC000-134	1.000
2113-06-0008	JACK, FEMALE, 5-CKT	1.000
2113-06-0009	7-PIN JACK	1.000
2113-06-0010	JACK, 3-CKT	2.000
2113-06-0014	CONN, FEMALE, 2-PIN	2.000
2113-06-0016	CONN., FEMALE, 10-PIN	1.000
2113-07-0001	CONTACT MC000-068	12.000
2113-07-0002	CONTACT, MC000-131	12.000
2113-10-0001	HSG, MINI-LATCH, 5-PIN	1.000
2113-10-0002	HSG, MINI-LATCH, 6-PIN	1.000
2113-10-0006	HSG, MINI-LATCH, 4-PIN	1.000
2113-10-0008	HSG, MINI-LATCH, 3-PIN	1.000
2113-10-0009	HSG, MINI-LATCH, 8-PIN	1.000
2113-20-0001	TERM, MINI-PV	2.000
2113-20-0002	TERM, MINI-PV, STRIP	22.000
2113-23-0001	PLUG, POLARIZING	4.000
2113-36-0002	HOOD	2.000
2310-00-0531	CRYSTAL, 82.850000MHZ	1.000
2310-00-1081	CRYSTAL, 2.0000 MHZ	1.000
2410-01-0034	KNOB, BLK, 1/8-IN	2.000
2410-01-0035	KNOB, BLK, 1/4-IN	2.000
2410-01-0038	KNOB	1.000
2410-01-0039	KNOB W/8-32 SET	2.000
2410-01-0040	KNOB, DUAL, BLK. W/SET SCREWS	1.000
2410-02-0008	LAMP	4.000
2410-03-0006	DSPLY, LCD, 4-DGT, .5IN	1.000
2410-04-0001	DECAL, SER. NO.	1.000
2410-04-0181	DECAL, H.V. 2022	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
2410-04-0463	DECAL, ATTEN DRUM	2.000
2410-05-0001	FUSE, S.B., 2AMP	1.000
2410-05-0017	FUSEHLDR/LINE RECEPT	1.000
2410-06-0022	METER, SAM	1.000
2410-08-0011	BEZEL, 7 IN	1.000
2411-04-0058	7570-06 DECAL, ATTEN.	1.000
2414-14-0002	DECAL, SAM GUARANTEE	1.000
2416-14-0001	DECAL, CAUTION	1.000
2710-02-0002	FILTER, SFE, 10.7MA	1.000
2810-00-0004	CABLE CLAMP, 1/4	1.000
2810-00-0008	CABLE CLAMP, 3/16	1.000
2810-00-0010	CABLE TIE, 4	10.000
2810-02-4104	SPACER, HEX, 4-40X1/4	4.000
2810-02-4108	SPACER, THD, 4-40X1/2	2.000
2810-02-6103	SPACER, 6-32X3/16	4.000
2810-02-6106	SPACER, 6-32X3/8	2.000
2810-02-6108	SPACER6-32X1/2HEX, LG	4.000
2810-04-2005	SPACER, 2X5/16, 3/16OD	1.000
2810-05-0015	STANDOFF, SWAGE, .188,	4.000
2810-05-0017	1/8" SPACER	2.000
2810-07-0007	HANDLE, HH101-002	2.000
2810-10-0034	RUBBER GROMMET	2.000
2810-11-0020	SHOULDER WASHER, BK	2.000
2810-11-0021	HEATSINK, TO-18	1.000
2810-11-0036	WASHER, STEEL COMPRSN	4.000
2810-11-0037	INSULATOR, ROUND MICA	4.000
2810-12-0036	ROLLER, NYLON STD.	2.000
2810-12-0037	GEAR, NYLON	2.000
2810-14-4100	NUT, 4-40, HN101-400	6.000
2810-14-4104	NUT, 4-40X1/4, NP	6.000
2810-14-6100	NUT, 6-32X1/4	1.000
2810-14-8100	NUT, HEX, 8-32	4.000
2810-15-0001	NUT, HEX, 3/8-32X1/2AF	8.000
2810-16-0015	NUT, HEX, #10-32, NP	2.000
2810-16-0018	NUT, HEX 6-32X5/16, ZP	4.000
2810-16-0019	NUT, HEX, 4-40X1/4X	2.000
2810-16-0020	NUT, DRESS, FLARED	5.000
2810-17-2103	SCW, SBH, 2-56X3/16	3.000
2810-17-2104	SCW, SBH, 2-56X1/4	1.000
2810-17-4104	SCW, SBH, 4-40X1/4	11.000
2810-17-4108	SCW, SBH, 4-40X1/2	2.000
2810-17-6104	SCW, SBH, 6-32X1/4	13.000
2810-17-8104	SCW, SBH, 8-32X1/4	1.000
2810-17-8106	SCW, SBH, 8-32X3/8	1.000
2810-17-8108	SCW, SBH, 8-32X1/2	4.000
2810-19-6103	SCW, SFH, 6-32X3/16	4.000
2810-23-0031	SCREW, PAN HD, BLK,	6.000
2810-23-0034	SCREW, SWG, PAN, PHIL	24.000
2810-23-0035	SCREW, PAN HD.,	1.000
2810-23-0043	SCREW, PAN HD,	7.000
2810-23-0062	SCREW, 2-56X5/16, BK	1.000
2810-23-0082	SCW, SFIL, 2-56X3/4	2.000
2810-25-4000	LWASHER, EXT, 4	4.000
2810-25-6000	LWASHER, EXT, 6	14.000
2810-25-8000	LWASHER, EXT, 8	4.000
2810-26-0012	WSHR, SPCR, 6, .140ID	10.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
2810-28-0003	LW,INT,SPEC,3/8 ID	5.000
2810-28-0010	WASHER,5804-43-1	1.000
2810-28-0027	WASHER, TENSION	2.000
2810-28-0041	WASHER,FLAT	9.000
2810-30-0011	RIVET	6.000
2810-42-4102	ST SCRW,SKT,4-40X1/8	1.000
2810-42-4103	SS,KN,CUP,4-40X3/16	1.000
2810-42-4106	SET SCREW,SKT,CUP PT	2.000
2810-43-6103	ST SCREW,CONE,SKT	6.000
2810-45-0003	FLANGED BEARING	2.000
2810-52-6105	SCW,PFH,6-32X5/16	4.000
2810-56-2103	SCW,PFIL,2-56X3/16	2.000
3010-11-0002	SPKR,2-1/4 45 OHM	1.000
3010-54-0004	MIXER,DBL.BAL.	1.000
3010-54-0005	MIXER,DBL.BAL.	1.000
3210-05-0043	G-10FR,1/16X10X12	1.041
3210-05-0044	G-10FR,1/16X12X16	0.833
3210-05-0046	G-10FR,1/16X12X16	0.590
3210-05-0047	G-10FR,1/32X10X12	0.500
3210-05-0052	G-10FR,1/16X12X18,	0.500
4510-00-0002	RELAY,SPDT MR000-002	3.000
4510-00-0019	RELAY,SNGL SD STB,	1.000
4510-00-0022	RELAY,DPDT,12 V	1.000
4610-00-1103	POT,10K,RP129-310	1.000
4610-00-1254	POT,250K,RP129-425	2.000
4610-00-2104	POT,100K,RP130-410	1.000
4610-00-2202	POT,2K,RP130-220	2.000
4610-00-3105	POT,1M,RP131-510	1.000
4610-00-3503	POT,50K,RP131-350	1.000
4610-01-4101	POT,100	3.000
4610-01-4102	POT,1K	1.000
4610-01-4103	POT,10K	3.000
4610-01-4202	POT,2K	2.000
4610-01-4203	POT,20K	2.000
4610-01-4204	POT,200K	2.000
4610-01-4205	POT,2M	1.000
4610-02-1103	POT,10K	1.000
4610-02-1503	POT,50K	4.000
4610-13-4202	POT,CERMET,2K	1.000
4610-13-4203	POT,CERMET,20K	1.000
4610-13-7103	POT 10K PC PER B/P	1.000
4610-14-7103	POT,10K,10T	1.000
4610-14-8253	POT,25K	1.000
4610-31-1102	POT/SWITCH,1K	1.000
4610-31-4103	POT/SWITCH,10K	1.000
4610-40-9105	POT,DUAL,1M/10K/M-SW	1.000
4610-50-1502	POT,5K	1.000
4700-05-2201	RES,C,1/8W,5%,2.2K	1.000
4700-05-4704	RES,C,1/8W,5%,4.7M	2.000
4700-15-1000	RES,C,1/4W,5%,100	1.000
4700-15-1001	RES,C,1/4W,5%,1K	23.000
4700-15-1002	RES,C,1/4W,5%,10K	32.000
4700-15-1003	RES,C,1/4W,5%,100K	11.000
4700-15-1004	RES,C,1/4W,5%,1M	2.000
4700-15-1005	RES,C,1/4W,5%,10M	1.000
4700-15-1009	RES,C,1/4W,5%,10	4.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4700-15-1201	RES,C,1/4W,5%,1.2K	1.000
4700-15-1202	RES,C,1/4W,5%,12K	1.000
4700-15-1302	RES,C,1/4W,5%,13K	1.000
4700-15-1500	RES,C,1/4W,5%,150	5.000
4700-15-1501	RES,C,1/4W,5%,1.5K	4.000
4700-15-1502	RES,C,1/4W,5%,15K	2.000
4700-15-1801	RES,C,1/4W,5%,1.8K	5.000
4700-15-2000	RES,C,1/4W,5%,200	1.000
4700-15-2001	RES,C,1/4W,5%,2K	5.000
4700-15-2002	RES,C,1/4W,5%,20K	3.000
4700-15-2200	RES,C,1/4W,5%,220	3.000
4700-15-2201	RES,C,1/4W,5%,2.2K	4.000
4700-15-2202	RES,C,1/4W,5%,22K	7.000
4700-15-2209	RES,C,1/4W,5%,22	1.000
4700-15-2401	RES,C,1/4W,5%, 2.4K	1.000
4700-15-2402	RES,C,1/4W,5%,24K	1.000
4700-15-2700	RES,C,1/4W,5%,270	1.000
4700-15-2701	RES,C,1/4W,5%,2.7K	8.000
4700-15-2702	RES,C,1/4W,5%,27K	5.000
4700-15-2708	RES,C,1/4W,5%,2.7	1.000
4700-15-3001	RES,C,1/4W,5%,3K	2.000
4700-15-3300	RES,C,1/4W,5%,330	1.000
4700-15-3301	RES,C,1/4W,5%,3.3K	5.000
4700-15-3900	RES,C,1/4W,5%,390	1.000
4700-15-3901	RES,C,1/4W,5%,3.9K	5.000
4700-15-3902	RES,C,1/4W,5%,39K	1.000
4700-15-4300	RES,C,1/4W,5%,430	1.000
4700-15-4301	RES,C,1/4W,5%,4.3K	1.000
4700-15-4302	RES,C,1/4 W,5%,43K	1.000
4700-15-4700	RES,C,1/4W,5%,470	13.000
4700-15-4701	RES,C,1/4W,5%,4.7K	9.000
4700-15-4702	RES,C,1/4W,5%,47K	10.000
4700-15-4703	RES,C,1/4W,5%,470K	2.000
4700-15-4709	RES,C,1/4W,5%,47	1.000
4700-15-5102	RES,C,1/4W,5%,51K	1.000
4700-15-5103	RES,C,1/4W,5%,510K	1.000
4700-15-5600	RES,C,1/4W,5%,560	1.000
4700-15-6200	RES,C,1/4W,5%,620	2.000
4700-15-6201	RES,C,1/4W,5%,6.2K	1.000
4700-15-6202	RES,C,1/4W,5%,62K	2.000
4700-15-6800	RES,C,1/4W,5%,680	1.000
4700-15-6801	RES,C,1/4W,5%,6.8K	1.000
4700-15-6803	RES,C,1/4W,5%,680K	2.000
4700-15-6804	RES,C,1/4W,5%,6.8M	1.000
4700-15-7509	RES,C,1/4W,5%,75	2.000
4700-15-8201	RES,C,1/4W,5%,8.2K	6.000
4700-15-8202	RES,C,1/4W,5%,82K	1.000
4700-15-9101	RES,C,1/4W,5%,9.1K	4.000
4700-15-9102	RES,C,1/4W,5%,91K	2.000
4700-15-9109	RES,C,1/4W,5%,91	2.000
4700-25-1004	RES,C,1/2W,5%,1M	1.000
4700-25-1209	RES,C,1/2W,5%,12	1.000
4700-25-1804	RES,C,1/2W,5%,1.8M	1.000
4700-25-2200	RES,C,1/2W,5%,220	2.000
4700-25-2201	RES,C,1/2W,5%,2.2K	1.000
4700-35-1502	RES,C,1W,5%,15K	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4700-35-3008	RES,C,1W,5%,3	2.000
4700-45-1800	RES,C,2W,5%,180	1.000
4700-46-1001	RES,C,2W,10%,1K	2.000
4701-03-1001	RES,MF,1/8W,1%,1K	2.000
4701-03-1002	RES,MF,1/8W,1%,10K	5.000
4701-03-1241	RES,MF,1/8WM1%,1.24K	2.000
4701-03-1821	RES,MF,1/8W,1%,1.82K	1.000
4701-03-2003	RES,MF,1/8W,1%,200K	3.000
4701-03-6042	RES,MF,1/8W,1%,60.4K	2.000
4701-03-6343	RES,MF,1/8W,1%,634K	1.000
4701-03-8251	RES,MF,1/8W,1%,8.25K	1.000
4701-13-1003	RES,MF,1/4W,1%,100K	1.000
4702-35-1000	RES,WW,5W,5%,100	1.000
4702-35-1008	RES,WW,5W,5%,1	6.000
4702-55-5008	RES,WW,3W,5%,5	1.000
4702-75-2000	RES,WW,10W,5%,200	1.000
4702-75-5009	RES,WW,10W,5%,50	1.000
4702-80-0001	RES,WW,11W,5%,22	1.000
4705-05-1000	RES,C,1/8W,5%,100	2.000
4705-05-1002	RES,C,1/8W,5%,10K	3.000
4705-05-1209	RES,C,1/8W,5%,12	2.000
4705-05-1509	RES,C,1/8W,5%,15	2.000
4705-05-2200	RES,C,1/8W,5%,220	2.000
4705-05-2202	RES,C,1/8W,5%,22K	5.000
4705-05-2409	RES,C,1/8W,5%,24-OHM	2.000
4705-05-2700	RES,C,1/8W,5%,270	2.000
4705-05-3000	RES,C,1/8W,5%,300	3.000
4705-05-3900	RES,C,1/8W,5%,390	4.000
4705-05-4301	RES,C,1/8W,5%,4.3K	2.000
4705-05-9101	RES,C,1/8W,5%,9.1K	2.000
4705-15-3301	RES,C,1/4W,5%,3.3K	1.000
4741-10-7008	RES,L-A,1/4W,1%,107	6.000
4741-11-8009	RES,L-A,1/4W1%,1.18K	2.000
4741-14-3008	RES,L-A,1/4W,1%,143	4.000
4741-20-5008	RES,L-A,1/4W,1%,205	2.000
4741-21-0009	RES,L-A,1/4W1%,2.10K	2.000
4741-26-7008	RES,L-A,1/4W,1%,267	4.000
4741-37-4008	RES,L-A,1/4W,1%,374	2.000
4741-45-3007	RES,L-A,1/4W,1%,45.3	2.000
4741-66-5008	RES,L-A,1/4W,1%,665	2.000
4741-76-8007	RES,L-A,1/4W,1%,76.8	4.000
4741-80-6007	RES,L-A,1/4W,1%,80.6	4.000
4741-84-5007	RES,L-A,1/4W,1%,84.5	4.000
4741-90-9007	RES,L-A,1/4W,1%,90.9	4.000
4799-99-9999	RES,VAL DET IN CALIB	2.000
4801-01-0825	DIODE,ZENER,6.2V	1.000
4801-01-4372	DIODE,ZENER,3.0V	1.000
4801-01-4745	DIODE,ZENER,16V	1.000
4801-01-5231	DIODE,ZENER,5.1V	2.000
4801-02-0003	DIODE,ZENER,12V	1.000
4801-02-0004	DIODE,ZENER,68V	1.000
4803-02-0006	DIODE,VARACTOR	1.000
4803-02-0011	DIODE,VARACTOR	2.000
4803-02-0020	DIODE, VARACTOR	2.000
4806-01-4004	DIODE,RECT,400V	8.000
4806-01-4007	DIODE,RECT,1000V	1.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4806-01-5624	DIODE,RECT,200V	4.000
4806-01-5802	DIODE,RECT,50V	1.000
4806-02-0005	DIODE BRIDGE	1.000
4806-02-0070	DIODE,RECT,7000V	5.000
4807-01-0034	DIODE,GE PT CONTACT	4.000
4807-01-0082	DIODE,SI PT CONTACT	1.000
4807-01-0914	DIODE,SIGNAL DIODE,SIGNAL	37.000
4810-02-0007	LED,RD,W/BEZEL	1.000
4810-02-0015	LED,GN,W/BEZEL	1.000
4810-02-0016	LED,YL,W/BEZEL	1.000
4812-02-0004	DIODE,SWITCHING	3.000
4901-03-9040	TRANS QA039-040	8.000
4901-03-9050	TRANS QA039-050	4.000
4901-03-9060	TRANS QA039-060	1.000
4901-04-3030	TRANSISTOR	1.000
4901-04-4160	JFET,N-CHANNEL	2.000
4901-05-1791	TRANSISTOR,NPN,	7.000
4901-05-3060	TRANS QA053-060	1.000
4902-00-0050	TRANS QB000-032	2.000
4902-00-0320	TRANSISTOR,POWER	1.000
4902-00-0350	TRANS QB000-029	1.000
4902-00-0360	TRANS QB000-030	1.000
4902-00-0550	TRANS QB000-027	1.000
4902-00-0901	TRANSISTOR, MOT ONLY	2.000
4902-00-0911	TRANSISTOR, MOT ONLY	2.000
4902-00-2420	TRANS QB000-023	2.000
4902-00-2520	TRANS QB000-022	1.000
4902-00-7030	TRANS QB000-024	1.000
4902-00-8030	TRANS QB000-025	2.000
4999-00-0007	TRANSISTOR	2.000
5104-00-0034	SWITCH,ROTARY	1.000
5104-02-0001	SWITCH WAFER, 8-POS	1.000
5105-00-0017	SWITCH,SLIDE	1.000
5106-00-0021	SWITCH,TOGGLE,W/HDWR	2.000
5106-00-0022	SWITCH,DPDT,W/HRDWR.	1.000
5106-00-0023	SWITCH,TOGGLE,SPDT	1.000
5106-00-0024	SWITCH,TOGGLE,SPDT	1.000
5106-00-0025	SWITCH,3PDT	1.000
5106-00-0031	SWITCH,ROCKER,DPDT	1.000
5106-03-0001	SWITCH FRAME	1.000
5108-00-0003	KEYBOARD, 16 KEY	1.000
5610-00-0022	XFMR,HV,TT002-028	1.000
5610-00-0037	XFMR,PWR,48VCT,1.6A	1.000
5710-00-0018	CRT, 7 IN, P39	1.000
6010-72-4000	WIRE,MAGNET,24GA.	26.000
6010-72-8000	WIRE,MAGNET,28GA.	0.600
6010-73-2000	WIRE,MGNT,32GA,GN	8.000
6010-73-4000	MAGNET WIRE,34 GA.,	0.660
6010-91-4000	WIRE,BUS,14 GA	8.000
6010-91-8000	WIRE,BUSS,18 GA.	14.000
6011-12-0000	SLEEVING,TEF,TW,20GA	2.000
6011-12-2000	SLEEVING,TEF.TW,22GA	7.000
6011-20-2000	SLEEVING,SHRINKABLE,	0.500
6011-40-0001	CABLE,SUBMINAX,75	6.500
6011-40-0007	CABLE, RG59B/U,	6.000
6011-40-0008	CABLE, RG174/U, CABLE,	46.750

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
	RG174/U, (5000FT/SPLS)	
6011-40-0012	CABLE, 59/U, DBL SHLD	52.000
	CABLE, 59/U, DBL SHLD	
6011-60-0003	RAINBOW CABLE, 20COND 7/36 STRAND	14.000
6011-70-0005	CABLE, 5-COND, 22GA	5.000
6011-80-0006	LINE CORD, 3-COND, SVT	1.000
6012-00-0001	TEST LEADS	1.000
6012-12-2555	WIRE, 22, GN	7.750
6012-12-2889	WIRE, 22, GY/WH	8.000
6012-12-2993	WIRE, 22, WH/OR	7.500
6012-12-2996	WIRE, 22, WH/BL	8.000
6012-12-2999	WIRE, 22, WH	7.750
6012-12-4111	WIRE, 24GA, BN	18.000
6012-12-4444	WIRE, 24GA, YL	18.000
6012-12-4777	WIRE, 24GA, VI WIRE, 24GA, VI FROM: 6012-12-4999	44.000
6012-12-4999	WIRE PVC, 24GA, WH	106.000
6012-31-8000	WIRE, 18, BK	5.500
6012-31-8111	WIRE, 18, BN	1.250
6012-31-8555	WIRE, 18, GN	9.000
6012-31-8999	WIRE, 18 GA, WHT	16.750
7000-00-8200	DUAL OP AMP	2.000
7000-03-1100	VOLTAGE COMPARATOR	1.000
7000-03-2400	QUAD OP AMP	5.000
7000-03-4000	REGULATOR, 15V	1.000
7000-03-8000	AUDIO POWER AMP	1.000
7000-05-9000	IC	1.000
7000-08-0910	A/D CVTR/8-CH MUX	1.000
7000-13-3000	DETECTOR/BUFFER	1.000
7000-13-5000	IF AMP	2.000
7000-14-5800	DUAL OP AMP	1.000
7000-14-5801	DUAL OP AMP, MOT	1.000
7000-31-6000	WIDE-BAND OP AMP	5.000
7000-76-6000	VOLTAGE CONVERTER	1.000
7000-78-1500	VOLT REG, +15V	1.000
7000-79-1500	NEG VOLTAGE REG	1.000
8000-04-9400	PULSE WD MOD CTL CKT	1.000
8000-05-5810	DAC, 8-BIT	2.000
8000-06-3610	FREQ DIVIDER	1.000
8000-18-0210	MICROPROCESSOR	1.000
8000-18-2310	RAM, 128 WORD X 8-BIT	1.000
8000-18-5210	I/O PORT, 8-BIT	3.000
8000-18-5310	N-BIT, 1 OF 8 DECODER	1.000
8000-27-3210	EPROM, 4096X8	1.000
8000-40-1312	DCD/DEC DCDR	2.000
8000-40-2002	COUNTER, 14 STAGE BIN	1.000
8000-40-4012	BINARY CTR/DVDR	1.000
8000-40-5610	LCD DRIVER	4.000
8000-40-6810	NAND/AND, 8-INPUT	1.000
8000-45-0810	DUAL 4-BIT LATCH	1.000
8001-40-4210	QUAD LATCH	2.000
8001-40-6912	HEX INVERTER	2.000
8001-40-7610	QUAD D, REGISTER	1.000
8001-40-8110	QUAD AND GATE	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
8004-01-0712	DUAL 2-INP NAND DRVR	1.000
8007-41-6110	SYNC 4-BIT COUNTER	4.000
8007-49-2210	16-KEY ENCODER	1.000
8410-00-0041	PROM, SAM IIID-UHF REV B	1.000

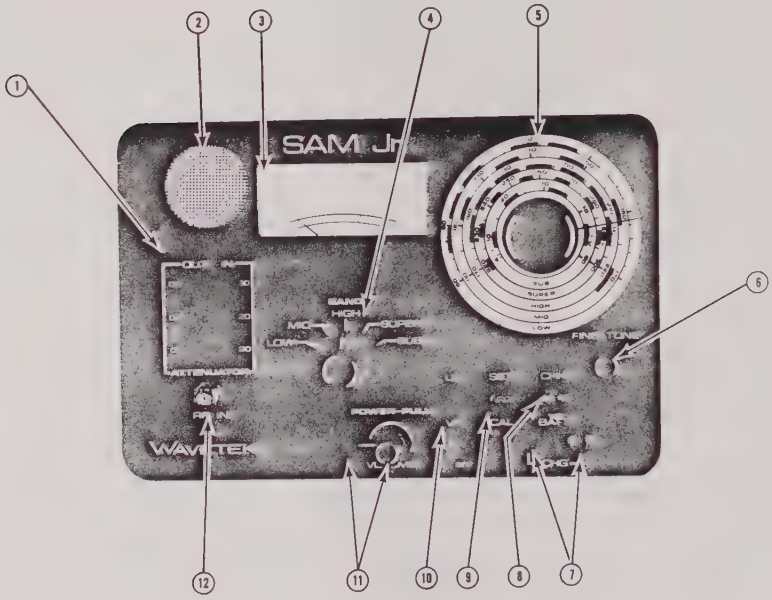
667 records listed.

INTRODUCTION

The Sam Jr. is our most inexpensive signal level meter. It is a full performance meter with a basic design. It has the same RF as our Sam I units with only a slightly relaxed amplitude accuracy specification. The Sam Jr. utilizes all electronic tuning.

It is available in a 10 MHz to 300 MHz, 10 MHz to 450 MHz, 50 MHz to 450 MHz, and also in a UHF range which is not normally available in a meter of this price range. All of these different ranges are available without the use of adapters or compensators. The mechanical design of this unit can handle the rough treatment that field meters receive.

MODEL SAM JR. FRONT PANEL

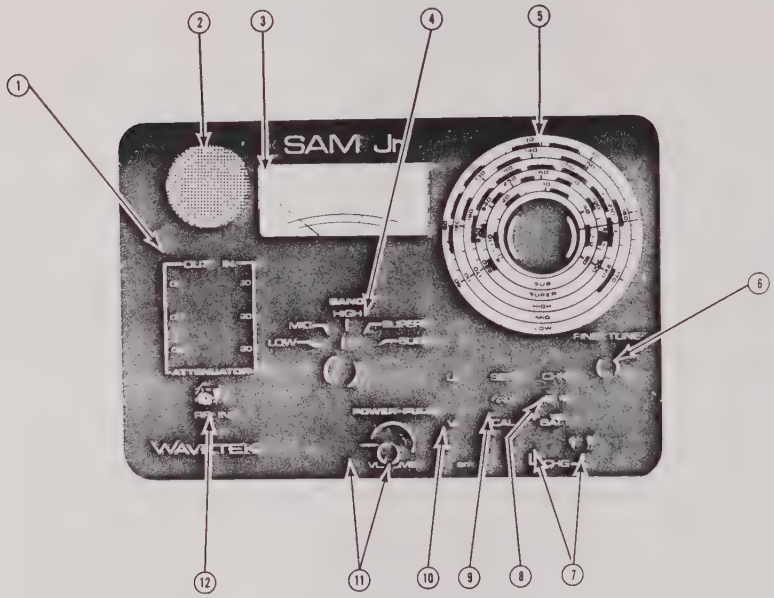


ITEM	DESCRIPTION	PART NUMBER
1	Attenuator	1113-20-0056
		2410-01-0037
2	Speaker Grill	1410-01-1960
3	Meter	2410-06-0010
4	Bandswitch Knob	2410-01-0039
5	Course Tune Knob	2410-01-0042
6	Fine Tune Knob	2410-01-0034
7	DC Recepticle	2112-32-0001
	Charge Light	4810-02-0007
	Battery Charger	4010-00-0019
8	Battery Check Switch	5106-00-0020
9	Calibration Set Control	4610-50-1253
10	UHF/VHF Switch-Optional	5106-00-0022
11	DISP/Power Knob	2410-01-0035
	On LED	4810-02-0007
12	RF In Connector	2110-06-0004

SPECIFICATIONS FOR MODEL SAM Jr.

SIZE	6½" high x 11" wide x 10" deep 6½" deep
WEIGHT	5 lb. 12 oz.
BATTERY	Rechargeable Nickle Cadmium
AC POWER REQUIREMENTS Charging only	110 VAC ± 10% 50 to 60 Hz; 15 W
AMPLITUDE RANGE	-35 to +60 dBmV
AMPLITUDE ACCURACY	± .75 dB
TEMPERATURE RANGE	0 to 120° F
TEMPERATURE ACCURACY	± 2 dB
FREQUENCY RANGES	10 to 300 MHz 10 to 450 MHz 50 to 450 MHz 470 to 890 MHz
SELECTIVITY	Sufficient to distinguish between two FM signals of equal amplitude 600 kHz apart.
I.F. BANDWIDTH	600 kHz at 3 dB, point, 1.3 MHz at 40 dB point

OPERATOR CONTROLS FOR MODEL SAM JR.

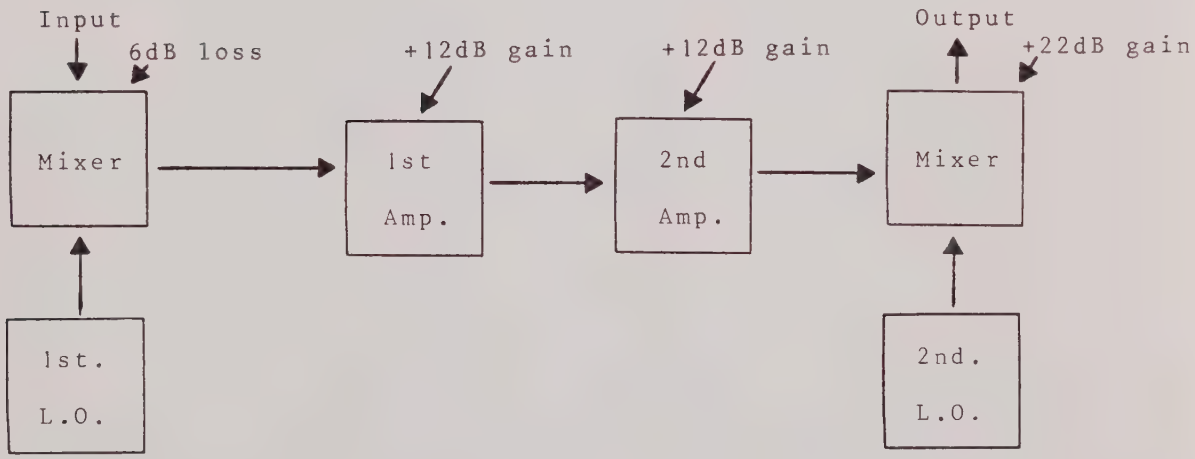


1	ATTENUATOR SWITCH	decreases the RF input level in 20 dB steps to provide an on-scale meter reading
2	SPEAKER	gives audio output of demodulated signal.
3	METER	indicates value of function being measured.
4	BAND SWITCH	selects tuning control frequency range.
5	TUNING CONTROL	selects the frequency to be measured.
6	FINE TUNE CONTROL	provides fine adjustments for tuning control setting.
7	CHARGE CONNECTOR	accepts AC input from battery charger. Lamp indicates the internal battery is being charged.
8	CHK. BATTERY SWITCH	gives battery charge indication on the meter.
9	SET CAL. CONTROL	calibrates the meter for amplitude measurements.
10	U/V SWITCH	selects UHF or VHF frequency range when UHF option is installed.
11	POWER/VOLUME CONTROL	applies DC power to the instrument when pulled out and adjusts the volume of the speaker output.
12	RF IN CONNECTOR	provides input for the signal to be measured.

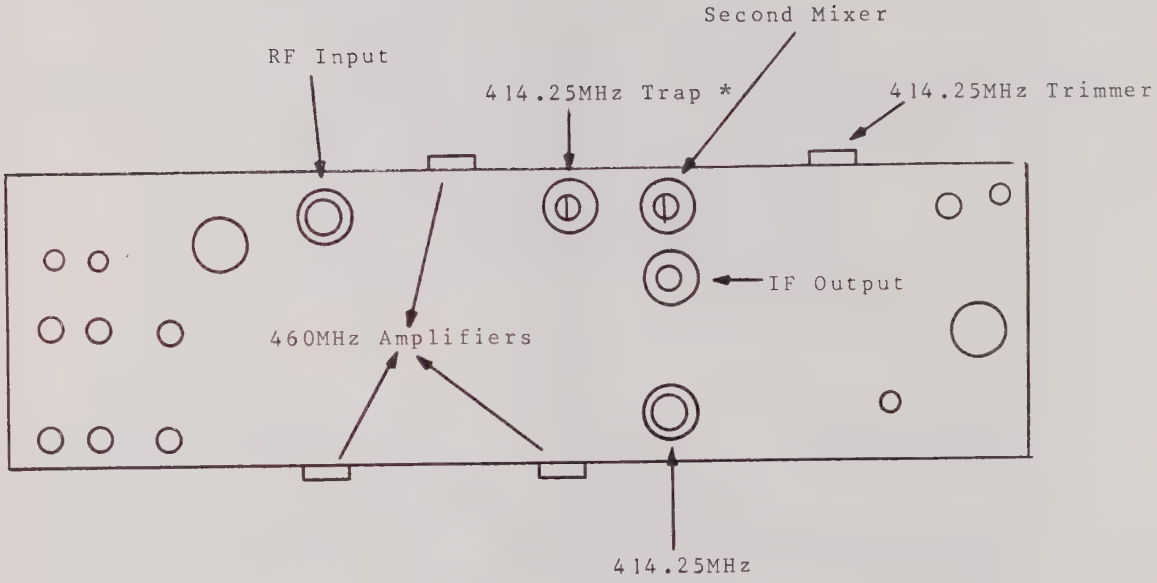
R.F. ASSEMBLY

The R.F. assembly is a frequency converter which converts all tuning ranges of the SAM to a common output of 45.75 MHz. The R.F. consist of a 1st L.O. which uses varactor tuning to feed the mixer with the incoming signal. The output of the mixer is 460 MHz. Two stages of I.F. amplification follow the mixer with about +12 dB of gain each. This amplified 460 MHz signal is then fed to another mixer circuit which is coupled to the 2nd L.O. (414.25) for a common output frequency of 45.75 MHz and is connected to the input of the main board I.F.

Some units have UHF coverage by using an added UHF tuning board (1st L.O.). Also, the 2nd L.O. may be crystal controlled, rather than the standard tuneable oscillator.



R.F ASSEMBLY



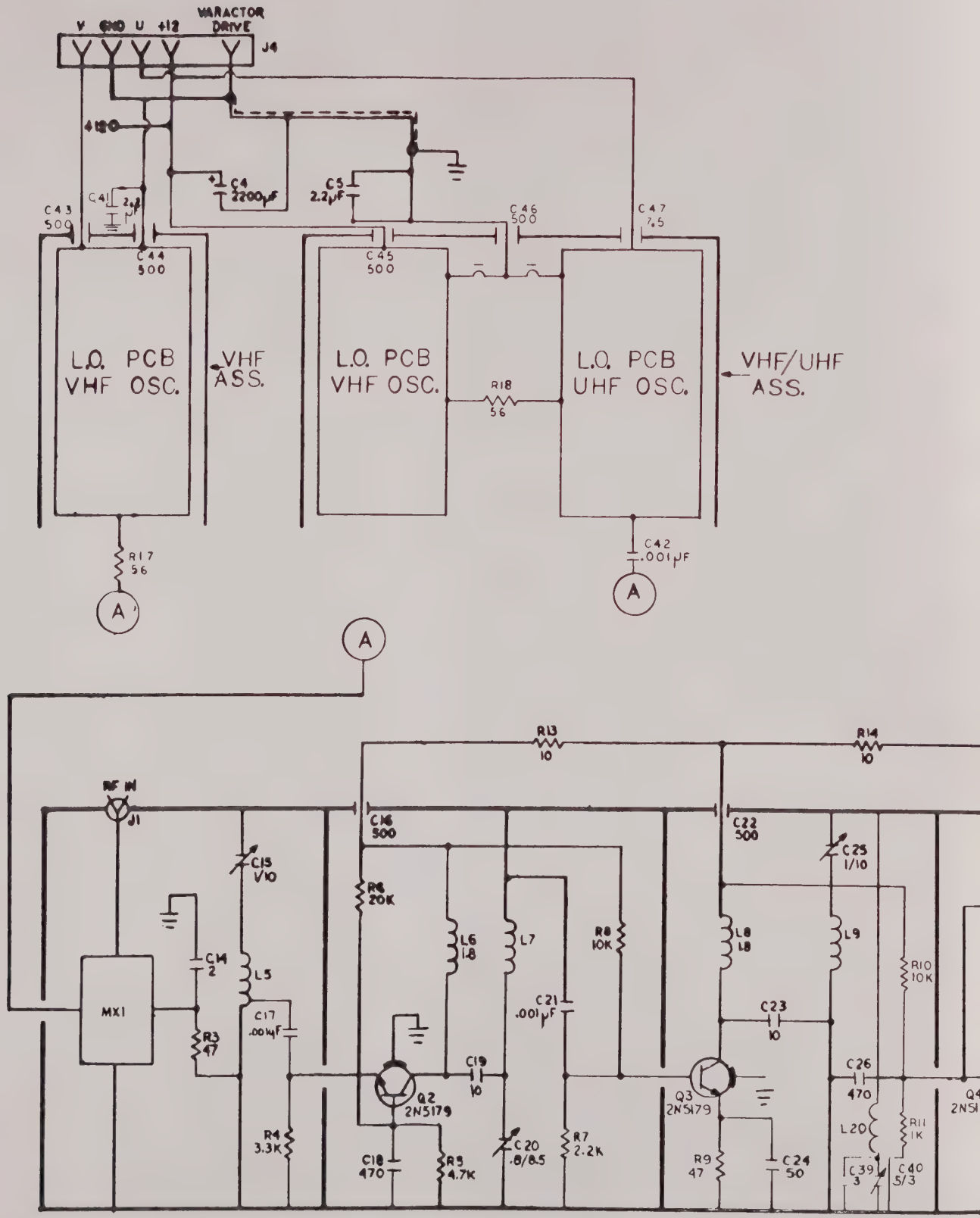
*This trimmer is used to adjust a 414.25MHz trap. This trap keeps the 2nd L.O. signal from feeding back into the IF which could cause a spur to occur at 414.25MHz. Only adjust this trimmer if the Sam indicates a signal at 414.25MHz, when no signal is applied to the Sam "RF in" connector on the front panel.

RF SPECIFICATIONS

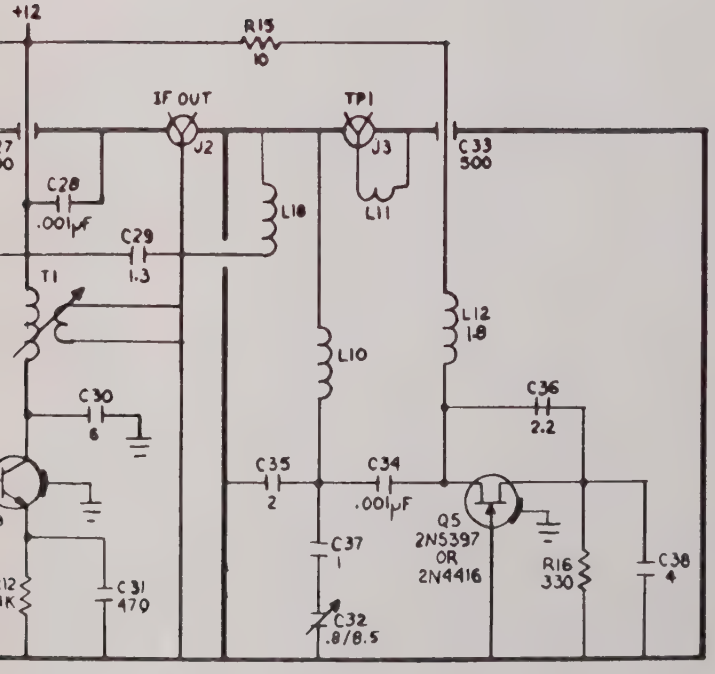
TYPE	GAIN	SWEEP WIDTH
Jr. 300	+36 dB - +40 dB	-12 - 310 MHz
Jr. 400	+36 dB - +40 dB	-12 - 410 MHz
Jr. 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
Jr. 450	+36 dB - +40 dB	-12 - 460 MHz
I 300	+36 dB - +40 dB	-12 - 310 MHz
I 400	+36 dB - +40 dB	-12 - 410 MHz
I450	+36 dB - +40 dB	-12 - 460 MHz
I 300 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
I 450 UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
II 300	+36 dB - +40 dB	-12 - 310 MHz
II 400	+36 dB - +40 dB	-12 - 410 MHz
II 450	+36 dB - +40 dB	-12 - 460 MHz
II 300	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 310 MHz 450 - 910 MHz
III 450	+36 dB - +40 dB	-12 - 460 MHz
III UHF	VHF +36 dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz
IV 450	+36dB - +40 dB	-12 - 460 MHz
IV UHF	VHF +36dB - +40 dB UHF ±1.5 dB	-12 - 460 MHz 460 - 910 MHz

NOTE

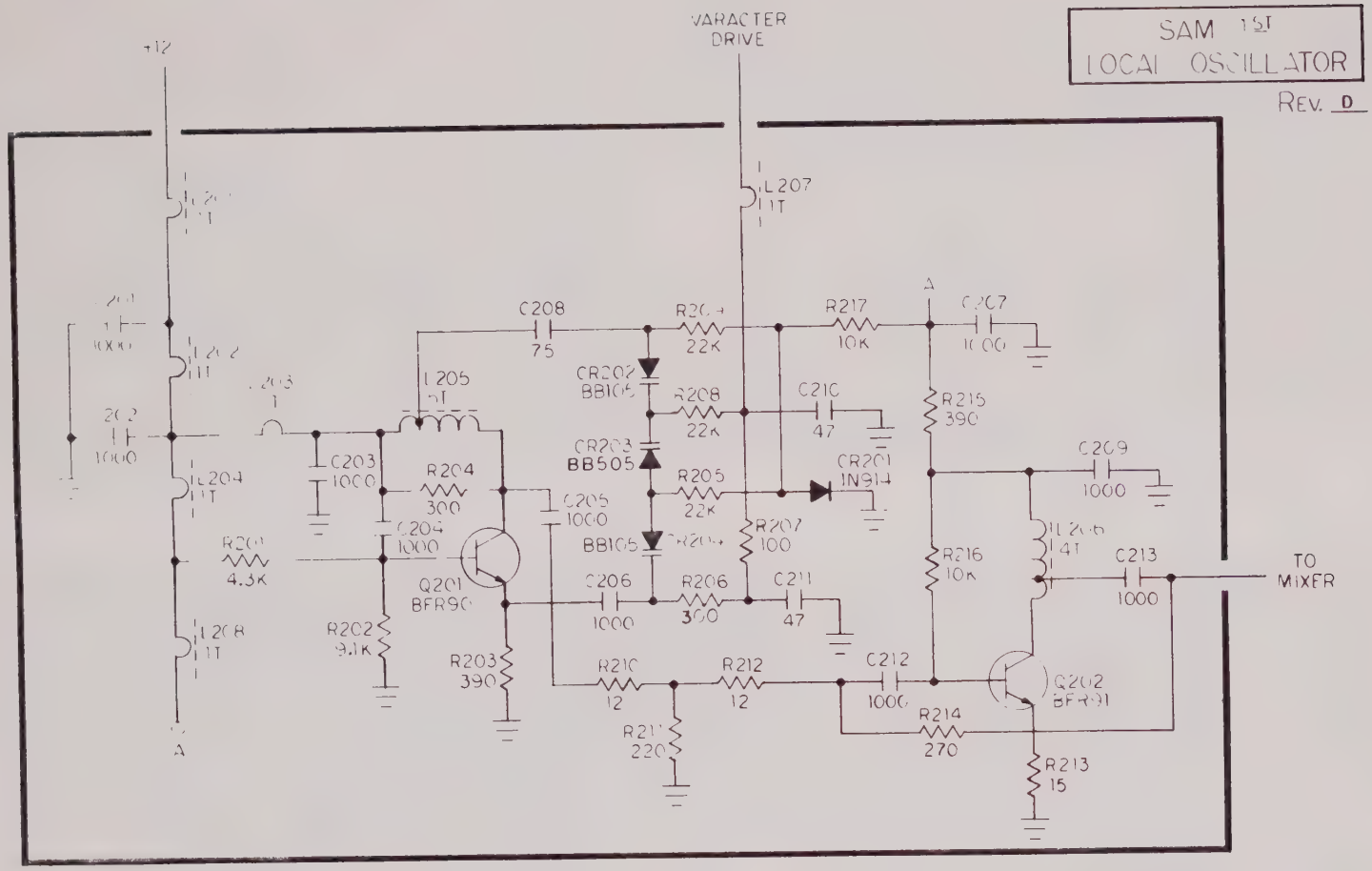
All of these RF specifications units with the analyzer option.


V
GND
U
+12
VARACTOR DRIVE
J4
+12V
C4 2200μF
C5 2.2μF
C41 2μF
C43 500
C44 500
C45 500
C46 500
C47 7.5
L.O. PCB VHF OSC.
VHF ASS.
L.O. PCB VHF OSC.
R18 56
L.O. PCB UHF OSC.
VHF/UHF ASS.
R17 56
C42 .001μF
A
A
A
RF IN
J1
MX1
C14 2
L5
C15 V10
C16 500
R6 20K
L6 1.8
L7
R8 10K
C17 .004μF
R3 47
C19 10
C21 .001μF
Q2 2N5179
R4 3.3K
C18 470
R5 4.7K
C20 .8/8.5
R7 2.2K
R13 10
R14 10
C22 500
C25 1/10
L8 1.8
L9
R10 10K
C23 10
C26 470
Q3 2N5179
L20
R11 1K
R9 47
C24 50
C39 3
C40 5/3

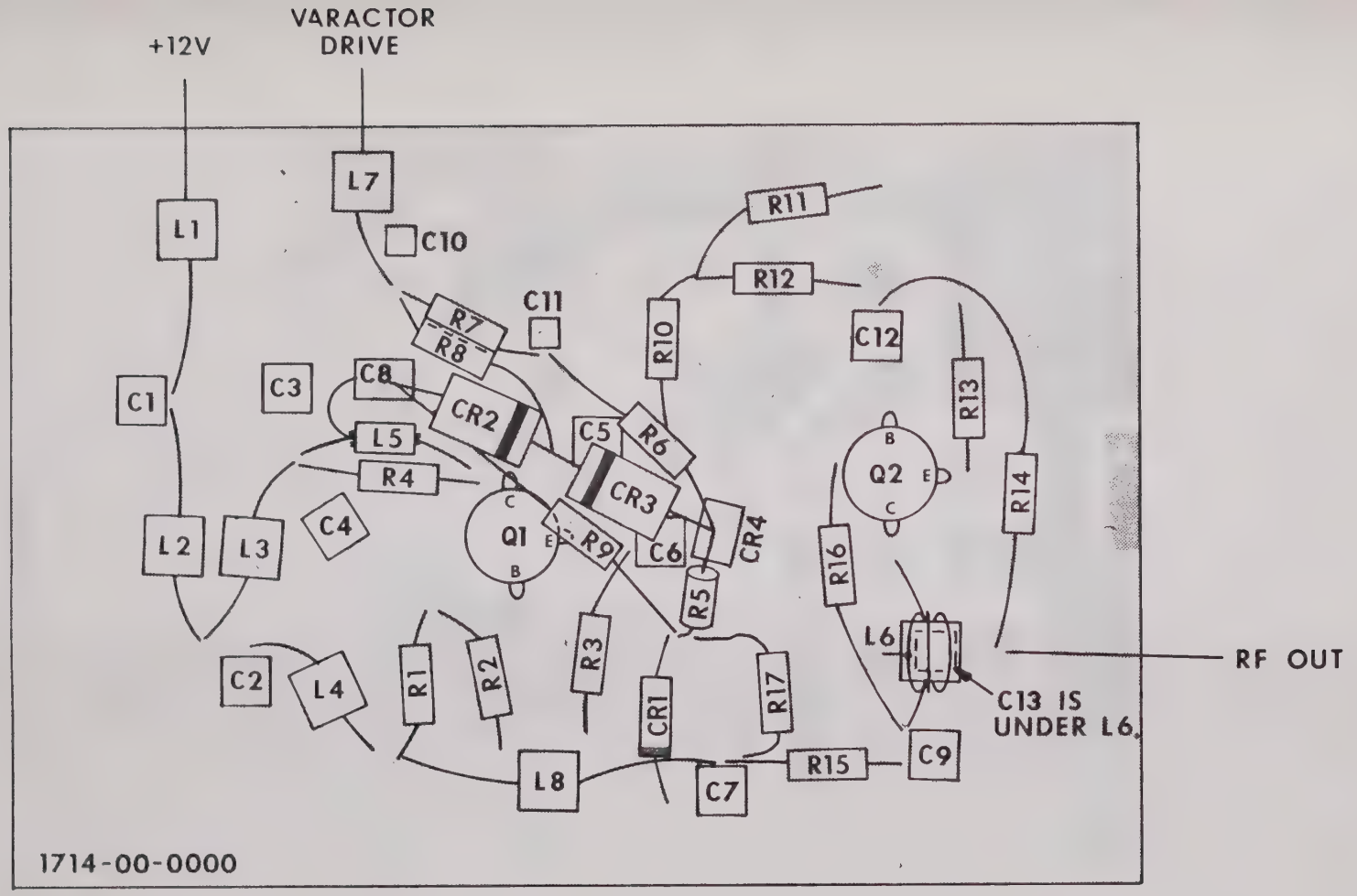
SAM I VHF/UHF – 450
RF ASSY



REVISIONS			WAVETEK
	ECN'S	BY	
A	D-1082	TJM	SAM I-450 VHF/UHF RF ASSY
B			
C			DRAWN BY: LT 8 — DATE: 2-8-82 — NUMBER: [redacted]
D			APP'D: — C919 30 0030
E			



REVISIONS			WAVETEK INDIANA		
	ECN'S	BY	SAM 1st LOCAL OSCILLATOR		
A	C028				
B	C034	G.L.R.			
C	C039	M.F.	DRAWN BY	DATE	NUMBER
D	C1021	WP	D. J. WATSON	3-10-82	0414-10-0001
E			APP'D		

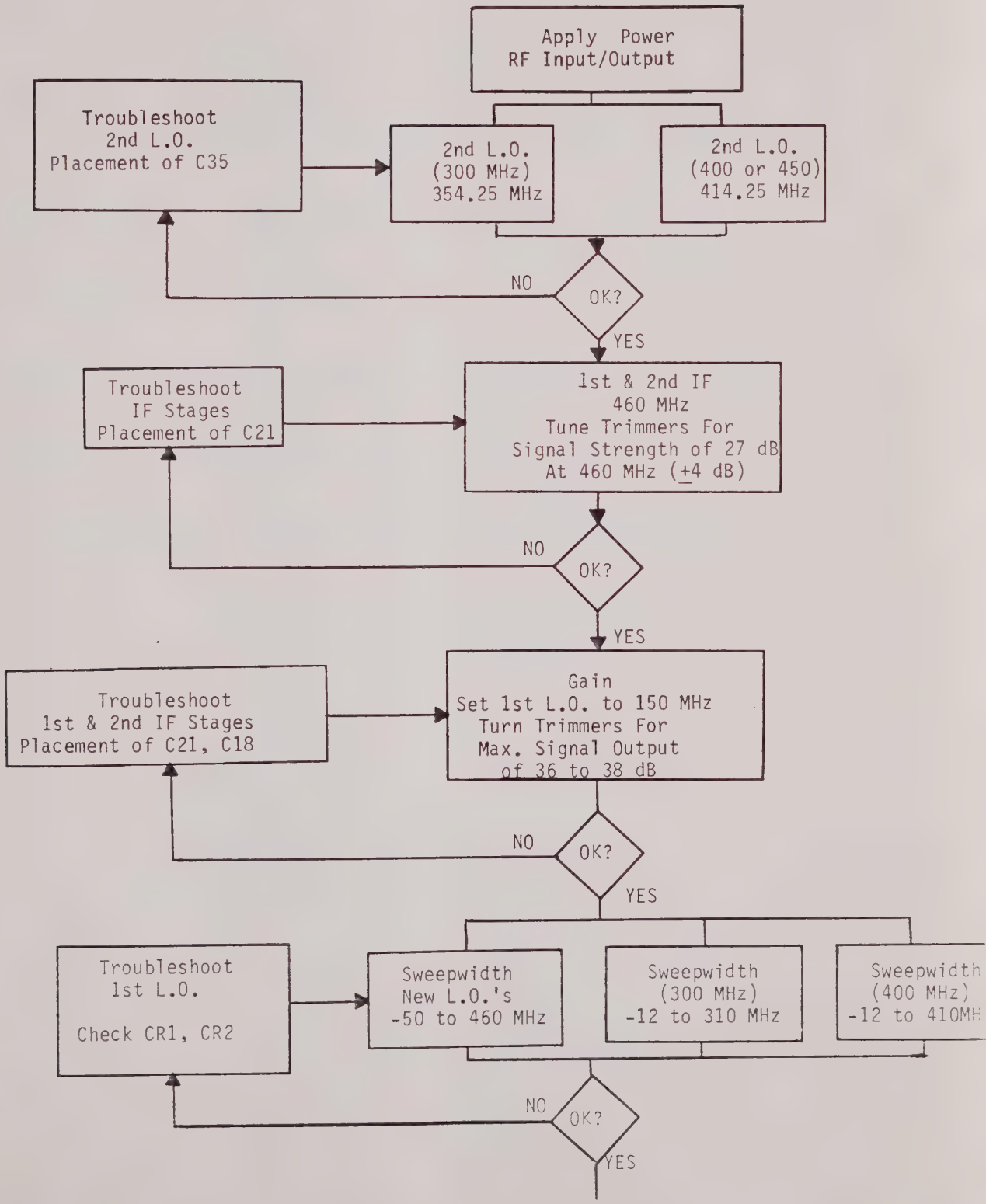


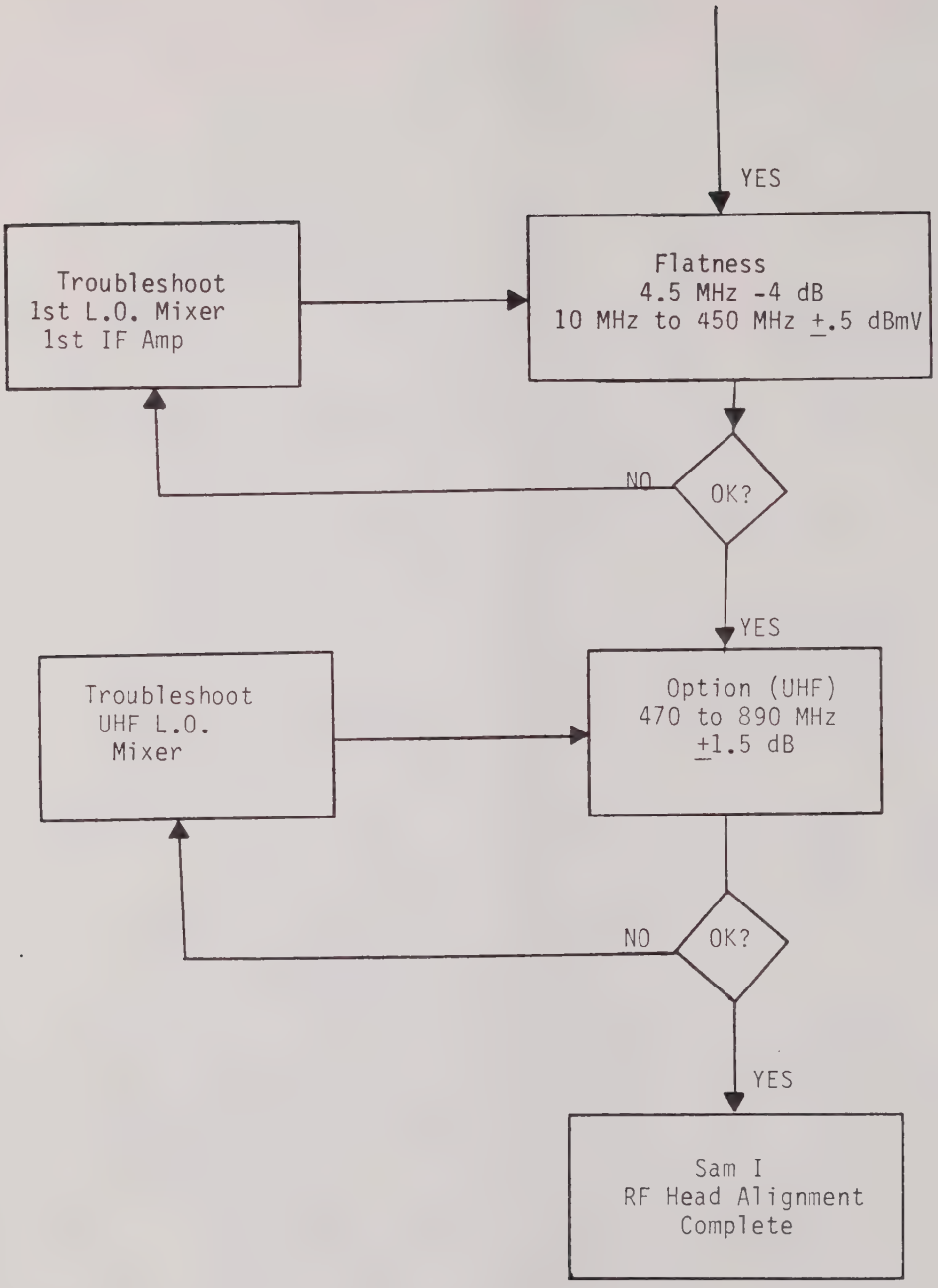
ALL REF. DES. ARE 200 SERIES

REVISIONS			WAVETEK INDIANA		
	ECN'S	BY	SAM 1ST LOCAL OSCILLATOR		
A					
B					
C			DRAWN BY	DATE	NUMBER
D			DJ WATSON	2-24-82	0412-0 0001
E			APP'D		

SAM JR. RF HEAD ALIGNMENT

(Generalized)




YES
Troubleshoot
1st L.O. Mixer
1st IF Amp
Flatness
4.5 MHz -4 dB
10 MHz to 450 MHz ±.5 dBmV
NO
OK?
YES
Troubleshoot
UHF L.O.
Mixer
Option (UHF)
470 to 890 MHz
±1.5 dB
NO
OK?
YES
Sam I
RF Head Alignment
Complete

RF TROUBLESHOOTING

Before taking voltage readings in the RF itself, be sure proper voltages are being supplied to the RF.

There is 12 V supplied to the oscillator board along with varactor drive 0 to 12 volts for tuning.

The first IF amp. transistor is a 5179 and should read approximately 1.6 volts on the emitter, 2.4 volts on the base, and 12 volts on the collector.

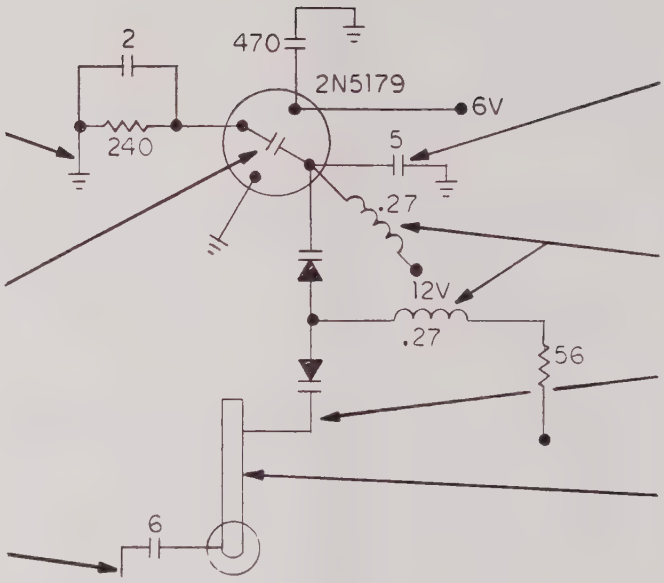
The second IF amp. transistor is also a 5179 which is coupled to the first amp. stage by its base and should read 2.2 volts, 1.3 volts for the emitter and 12 volts for the collector.

In the output mixer stage, a 5179 transistor is used. There should be 1.07 volts on the base which is connected to the 2nd amp. stage by a 470 pf. cap. The emitter should read .3 to .7 volts. The collector is supplied by 12 volts.

The second L.O. (not crystal controlled) uses a 4416 transistor. There should be 12 volts on the collector and 1.5 volts on the base.

If all voltages in the RF are correct, but it still does not meet gain, sweep, or flatness specs, the SAM should be returned, to Wavetek for repair and calibration.

SAM 300 1st L.O.



3A. Move grounded end to help sweep.

2A. To increase sweep change to 2.2 pf. To lower sweep change to 1.3 or 1.5 mud cap.

7A. Raising and lowering 6 pf. will help gain at 4.5 MHz.

6A. Change the position of the sweep cap to increase sweep.

1A. Change .27 chokes to to 1.8 to help sweep.

4A. To raise top end range, cut off some varactor lead.

5A. Raise frequency by lowering inductor. Lower frequency by raising inductor.

SWEEP

1B Be sure the red cap (470pf) is soldered close to the transistor or the signal will drop off on the high end.

2B If signal drops off before 300 MHz, try replacing the feedback cap 2pf with 1.3 or 1.5 mud caps, if you have plenty of frequency range.

3B Changing the position of the emitter cap and resistor will also change sweep.

4B Be sure the varactor voltage is correct before changing the varactors.

5B For best results, the main tuning inductor should be parallel with the bottom.

6B. Changing the position of the sweep cap can help increase sweep and improve linearity.

NOTE

Leaving the L.O. close to its original construction, will help sweep width, flatness, and linearity. Remove any solder blobs and long lengths of leads.

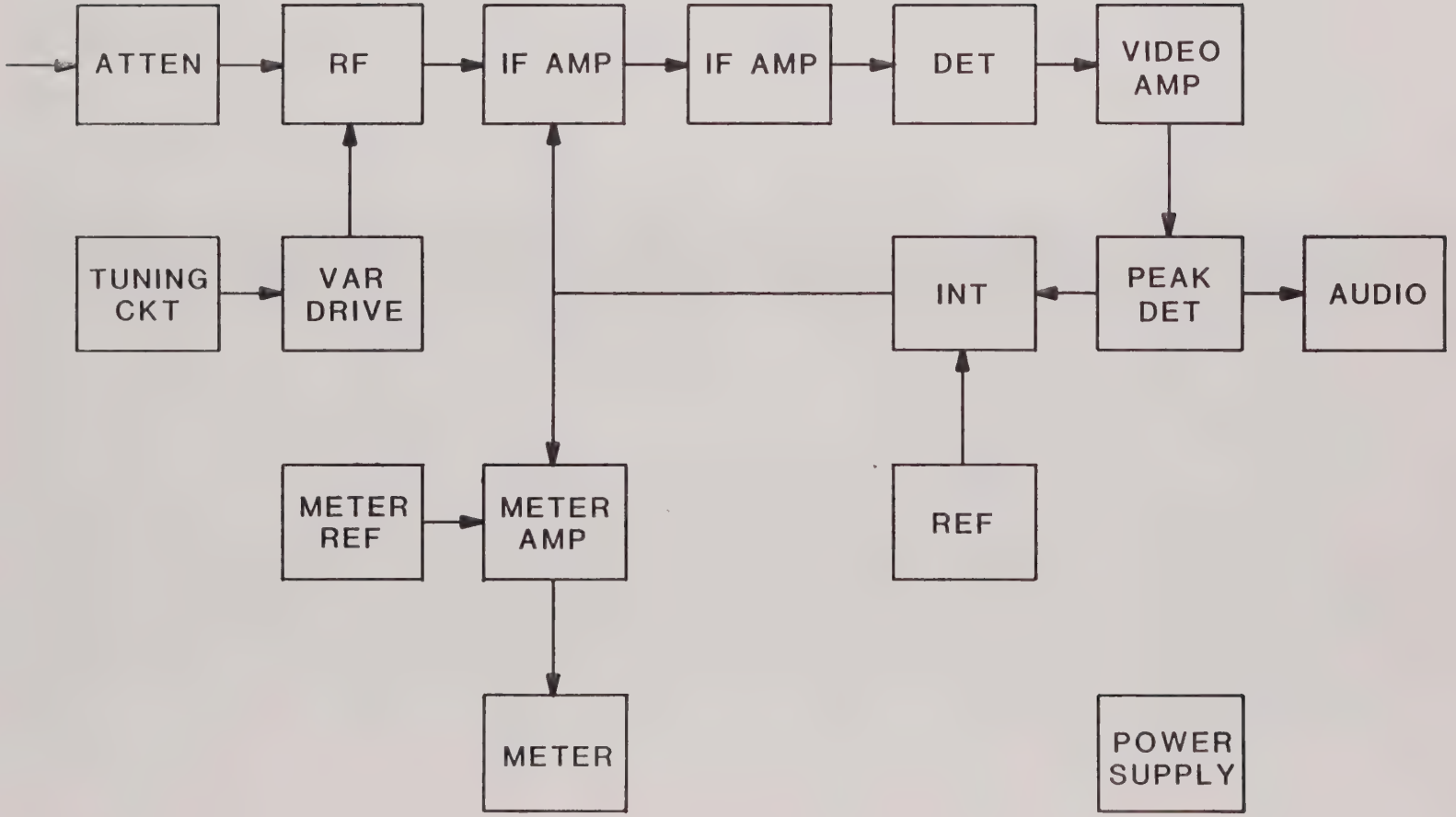
FLATNESS

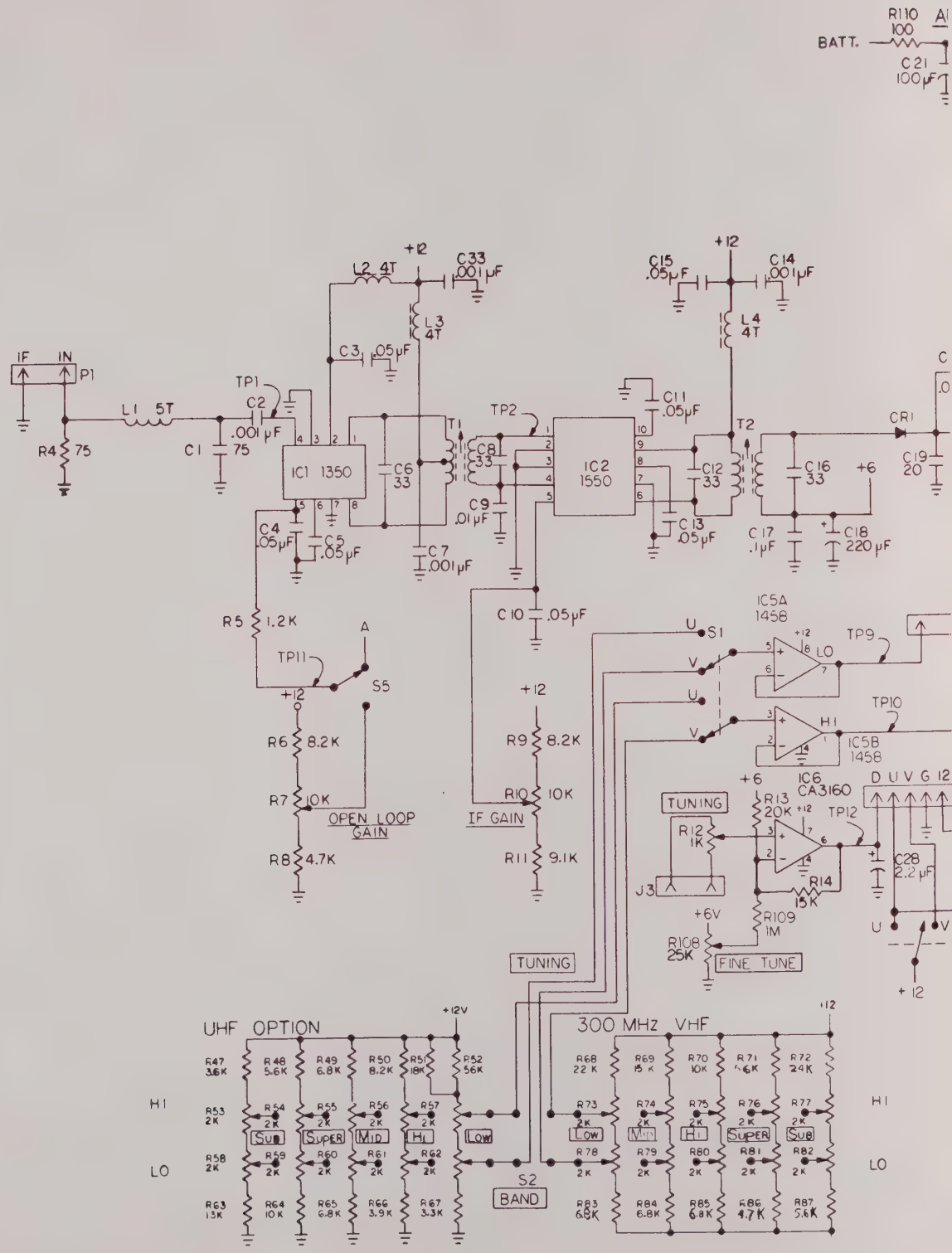
7B Adjust the 6 pf capacition for best low end flatness by moving it around for best results. Also shortening the leads of the 6pf will help.

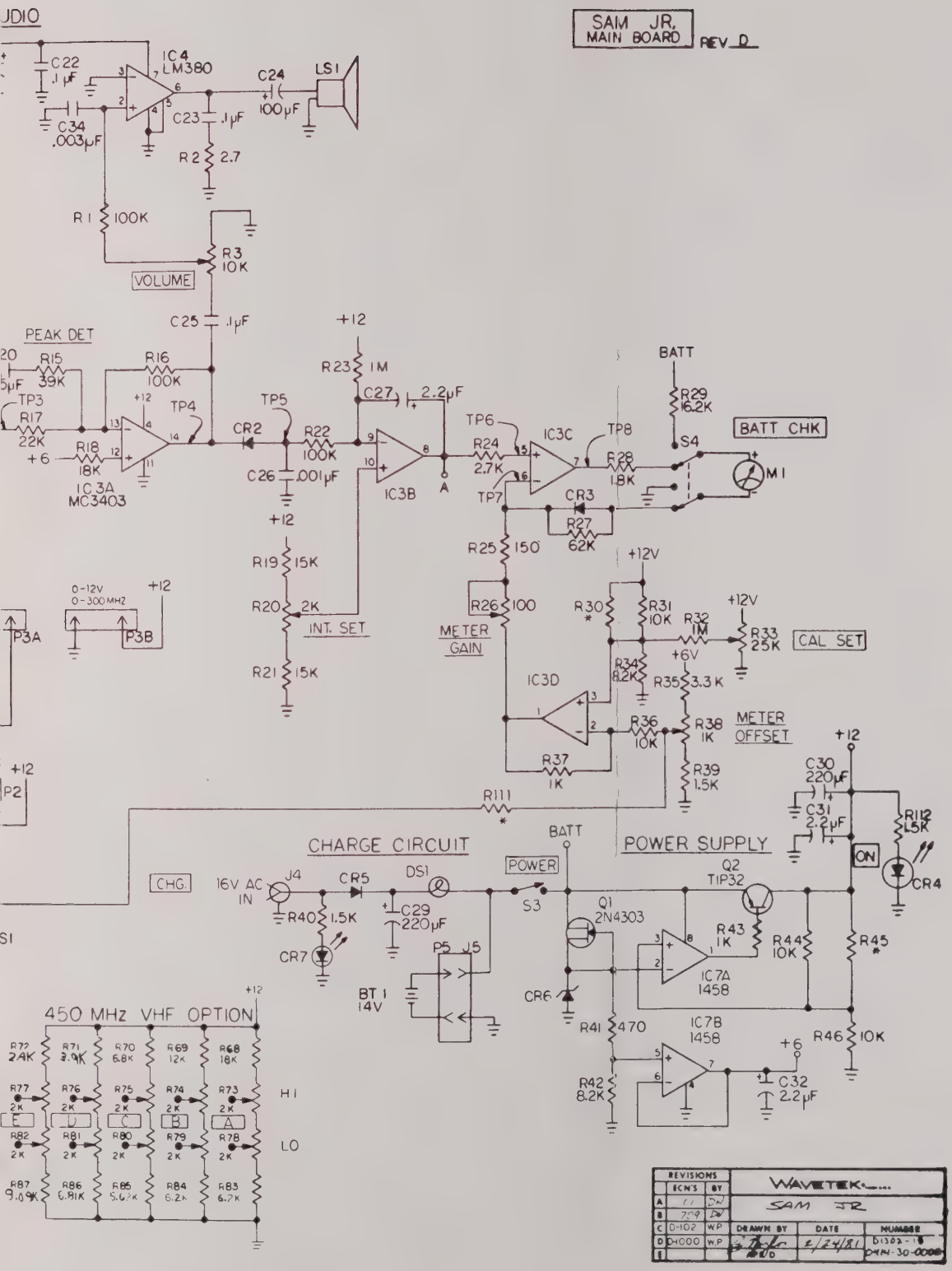
7C To help flatness at 4.5 MHz, resolder the tuning inductor higher up where it connects with the 6pf.

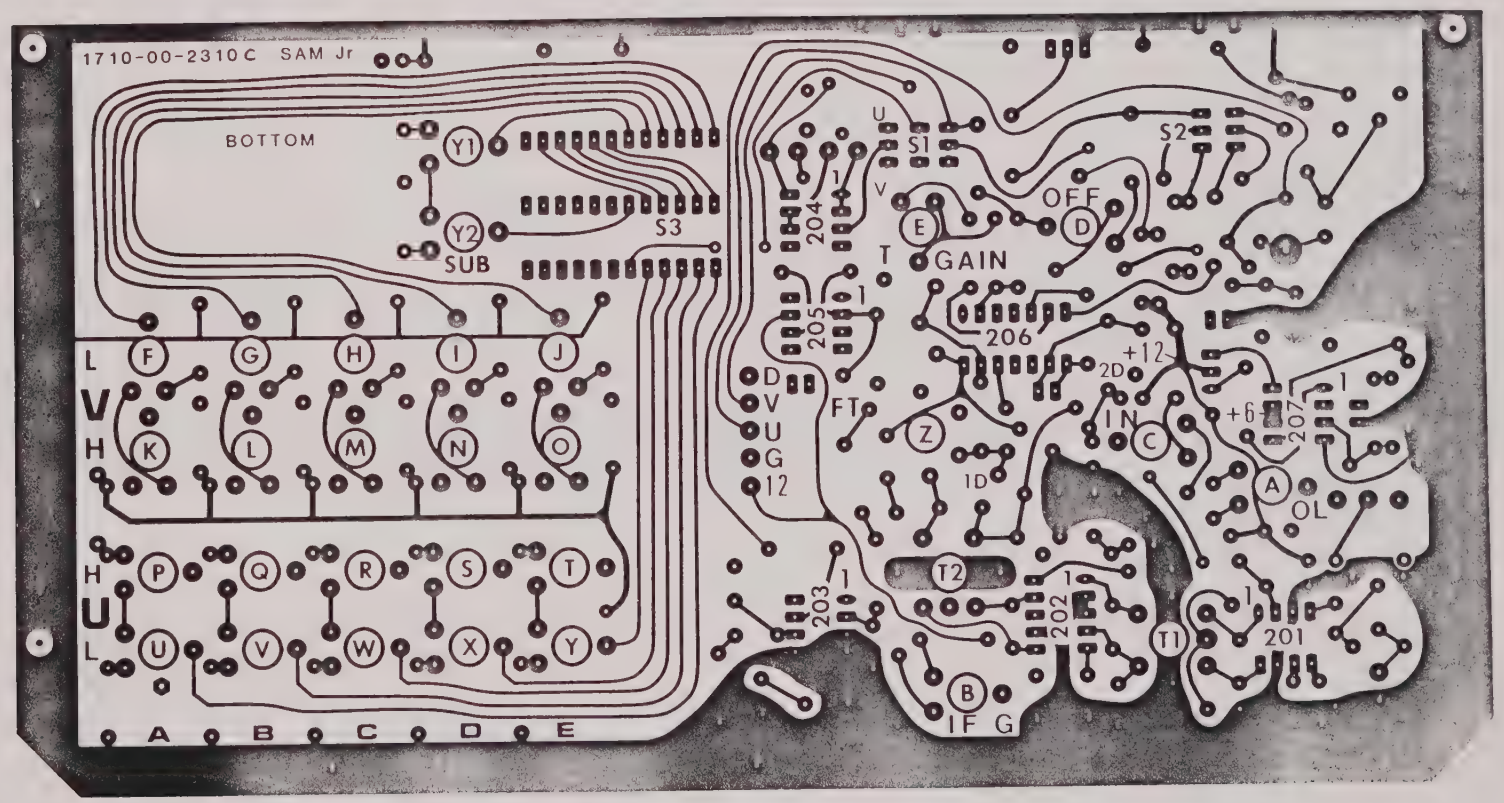
7D If flatness is still a problem at 4.5 MHz, remove the 2pf cap at the mixer input.

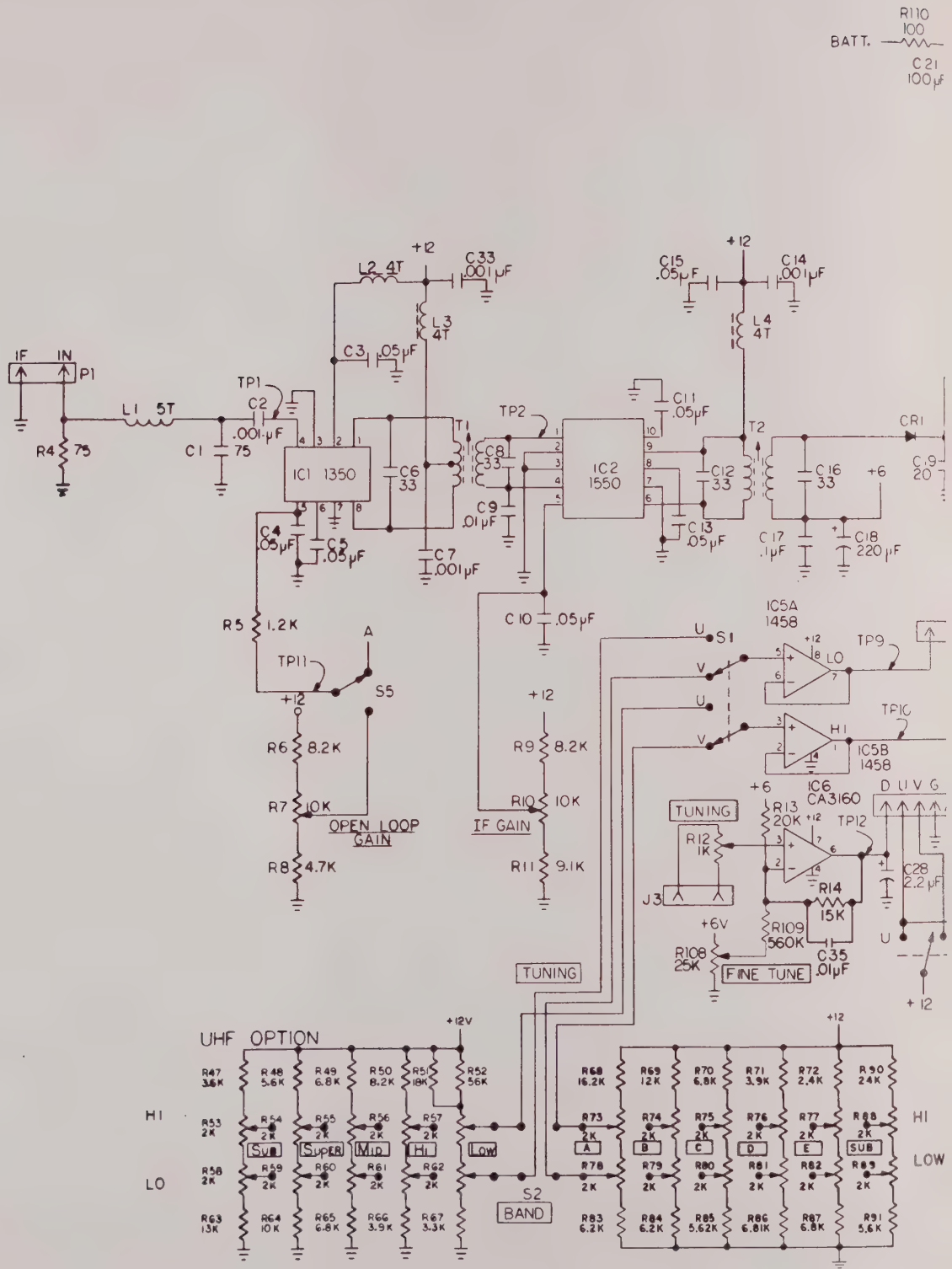
SAM Jr. Block Diagram

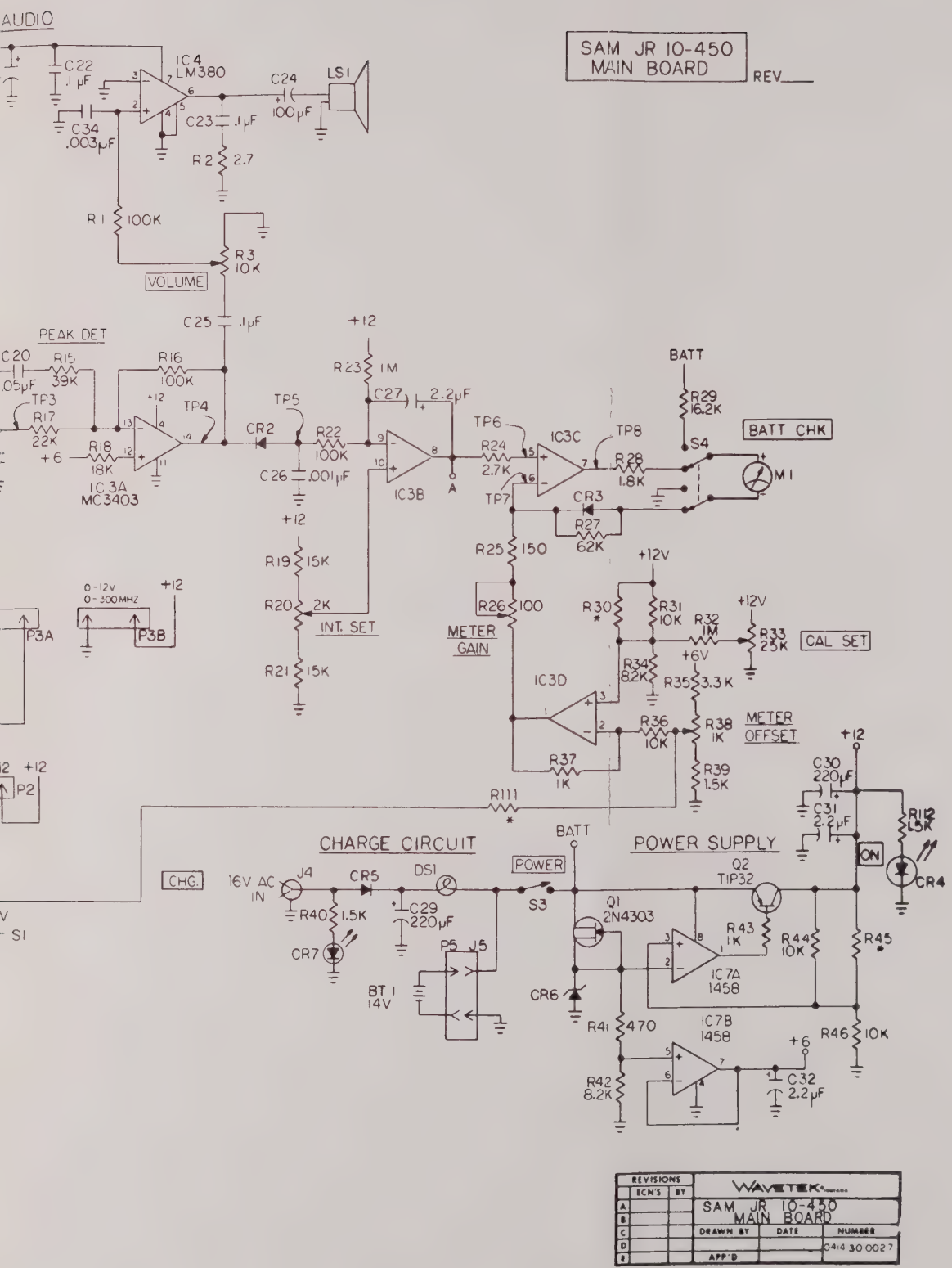



R110 A
100
BATT.
C21
100µF
+12
L2 4T
C33
.001µF
L3
4T
C3 .05µF
IF IN
P1
TP1
C2
.001µF
L1 5T
R4 75
C1
75
IC1 1350
C6
33
T1
TP2
C8
33
C9
.01µF
C4
.05µF
C5
.05µF
C7
.001µF
IC2
1550
C15
.05µF
C14
.001µF
L4
4T
C11
.05µF
T2
C12
33
C13
.05µF
C16
33
+6
C17
.1µF
C18
220µF
CR1
C19
20
C10 .05µF
R5 1.2K
A
TP11
S5
R6 8.2K
R7 10K
OPEN LOOP
GAIN
R8 4.7K
R9 8.2K
R10 10K
IF GAIN
R11 9.1K
U
S1
V
IC5A
1458
TP9
LO
TP10
H1
IC5B
1458
IC6
CA3160
D U V G 12
TUNING
R13
20K
TP12
R12
1K
J3
R14
15K
R109
1M
+6V
R108
25K
FINE TUNE
C28
2.2µF
+12
UHF OPTION
+12V
300 MHz VHF
R47 3.6K
R48 5.6K
R49 6.8K
R50 8.2K
R51 18K
R52 56K
R53 2K
R54 2K
R55 2K
R56 2K
R57 2K
R58 2K
R59 2K
R60 2K
R61 2K
R62 2K
R63 13K
R64 10K
R65 6.8K
R66 3.9K
R67 3.3K
SUB
SUPER
MID
HI
LOW
H1
LO
S2
BAND
R68 22K
R69 15K
R70 10K
R71 6.8K
R72 24K
R73 2K
R74 2K
R75 2K
R76 2K
R77 2K
R78 2K
R79 2K
R80 2K
R81 2K
R82 2K
R83 6.8K
R84 6.8K
R85 6.8K
R86 4.7K
R87 5.6K
LOW
MID
HI
SUPER
SUB
H1
LO


SAM JR.
MAIN BOARD
REV D
AUDIO
IC4
LM380
C22
.1µF
C34
.003µF
C24
100µF
LS1
C23
.1µF
R2
2.7
R1
100K
R3
10K
VOLUME
C25
.1µF
PEAK DET
R15
39K
R16
100K
TP3
R17
22K
TP4
R18
18K
IC3A
MC3403
CR2
TP5
R22
100K
C26
.001µF
+12
R23
1M
C27
2.2µF
IC3B
A
TP6
R24
2.7K
IC3C
TP8
R28
18K
BATT
R29
16.2K
S4
BATT CHK
M1
TP7
CR3
R27
62K
R25
150
R19
15K
R20
2K
INT. SET
R21
15K
R26
100
METER
GAIN
R30
*
R31
10K
R32
1M
R33
25K
CAL SET
+12V
+6V
R34
8.2K
R35
3.3K
IC3D
R36
10K
R38
1K
METER
OFFSET
R37
1K
R39
1.5K
R111
*
0-12V
0-300MHZ
P3A
P3B
P2
C30
220µF
C31
2.2µF
R112
1.5K
ON
CR4
CHARGE CIRCUIT
CHG.
16V AC
IN
J4
CR5
DS1
POWER
S3
BATT
POWER SUPPLY
Q2
TIP32
Q1
2N4303
R40
1.5K
CR7
C29
220µF
P5
J5
BT1
14V
CR6
R43
1K
R44
10K
R45
*
IC7A
1458
R41
470
IC7B
1458
R42
8.2K
R46
10K
C32
2.2µF
450 MHz VHF OPTION
R77
2.4K
R71
3.9K
R70
6.8K
R69
12K
R68
18K
R77
2K
R76
2K
R75
2K
R74
2K
R73
2K
E
D
C
B
A
R82
2K
R81
2K
R80
2K
R79
2K
R78
2K
R87
9.09K
R86
6.81K
R85
5.62K
R84
6.2K
R83
6.2K
HI
LO
REVISIONS
ECN'S
BY
A
B
C
D
E
C-102
D-000
WP
WAVETEK
SAM JR
DRAWN BY
DATE
NUMBER
2/24/81
D1303-1
04N-30-0000


1710-00-2310 C SAM Jr
BOTTOM
Y1
Y2
SUB
S3
S1
S2
OFF
GAIN
204
205
206
207
201
202
203
L
V
H
U
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
A
B
C
D
E
Z
T1
T2
IN
OL
+12
+6
IFG
FT
1D
2D


R110
100
BATT.
C21
100µF
IF IN
P1
L1 5T
R4 75
C1 75
TP1
C2
.001µF
IC1 1350
C3 .05µF
L2 4T
+12
C33
.001µF
L3
4T
C6
33
C4
.05µF
C5
.05µF
C7
.001µF
TP2
T1
C8
33
C9
.01µF
IC2
1550
C10 .05µF
C11
.05µF
C12
33
C13
.05µF
L4
4T
C15
.05µF
C14
.001µF
T2
C16
33
C17
.1µF
C18
220µF
CR1
C19
20
+6
R5 1.2K
A
TP11
S5
R6 8.2K
R7 10K
R8 4.7K
OPEN LOOP
GAIN
R9 8.2K
R10 10K
IF GAIN
R11 9.1K
U
V
S1
IC5A
1458
TP9
LO
HI
TP10
IC5B
1458
IC6
CA3160
TUNING
R13
20K
R12
1K
J3
TP12
R14
15K
R109
560K
R108
25K
FINE TUNE
C35
.01µF
C28
2.2µF
D U V G
+6V
TUNING
S2
BAND
UHF OPTION
+12V
R47 3.6K
R48 5.6K
R49 6.8K
R50 8.2K
R51 18K
R52 56K
R53 2K
R54 2K
R55 2K
R56 2K
R57 2K
SUB
SUPER
MID
HI
LOW
R58 2K
R59 2K
R60 2K
R61 2K
R62 2K
R63 13K
R64 10K
R65 6.8K
R66 3.9K
R67 3.3K
R68 16.2K
R69 12K
R70 6.8K
R71 3.9K
R72 2.4K
R90 24K
R73 2K
R74 2K
R75 2K
R76 2K
R77 2K
R88 2K
A
B
C
D
E
SUB
R78 2K
R79 2K
R80 2K
R81 2K
R82 2K
R89 2K
R83 6.2K
R84 6.2K
R85 5.62K
R86 6.81K
R87 6.8K
R91 5.6K
HI
LO
HI
LOW

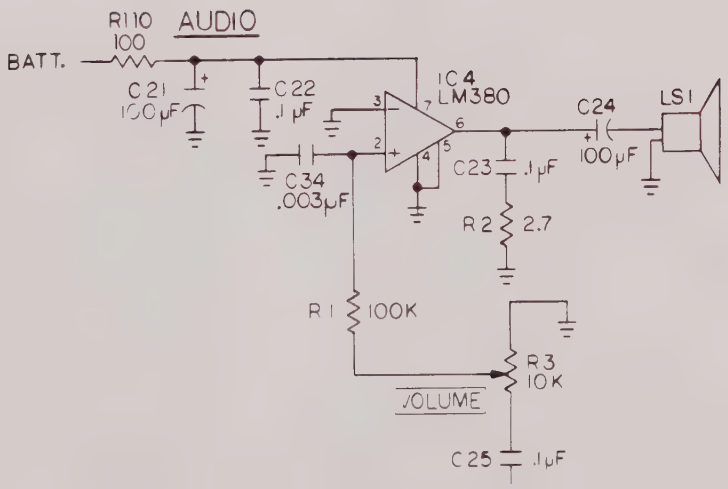


REVISIONS			WAVETEK
	ECN'S	BY	SAM JR 10-450 MAIN BOARD
A			
B			
C			DRAWN BY / DATE / NUMBER
D			
E			APP'D / 0414 30 0027

THEORY OF OPERATION

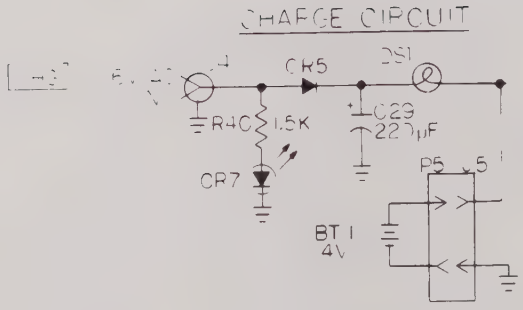
AUDIO

The demodulated signal at TP4 is capacitively coupled through C25 to volume control R3. The wiper of R3 is connected to pin 2 of IC4 through R1. IC4 has an internal gain of approximately 200. This signal is then coupled through C24 to the speaker. The purpose of C23 and R2 is to prevent high frequency (100 kHz) oscillations.



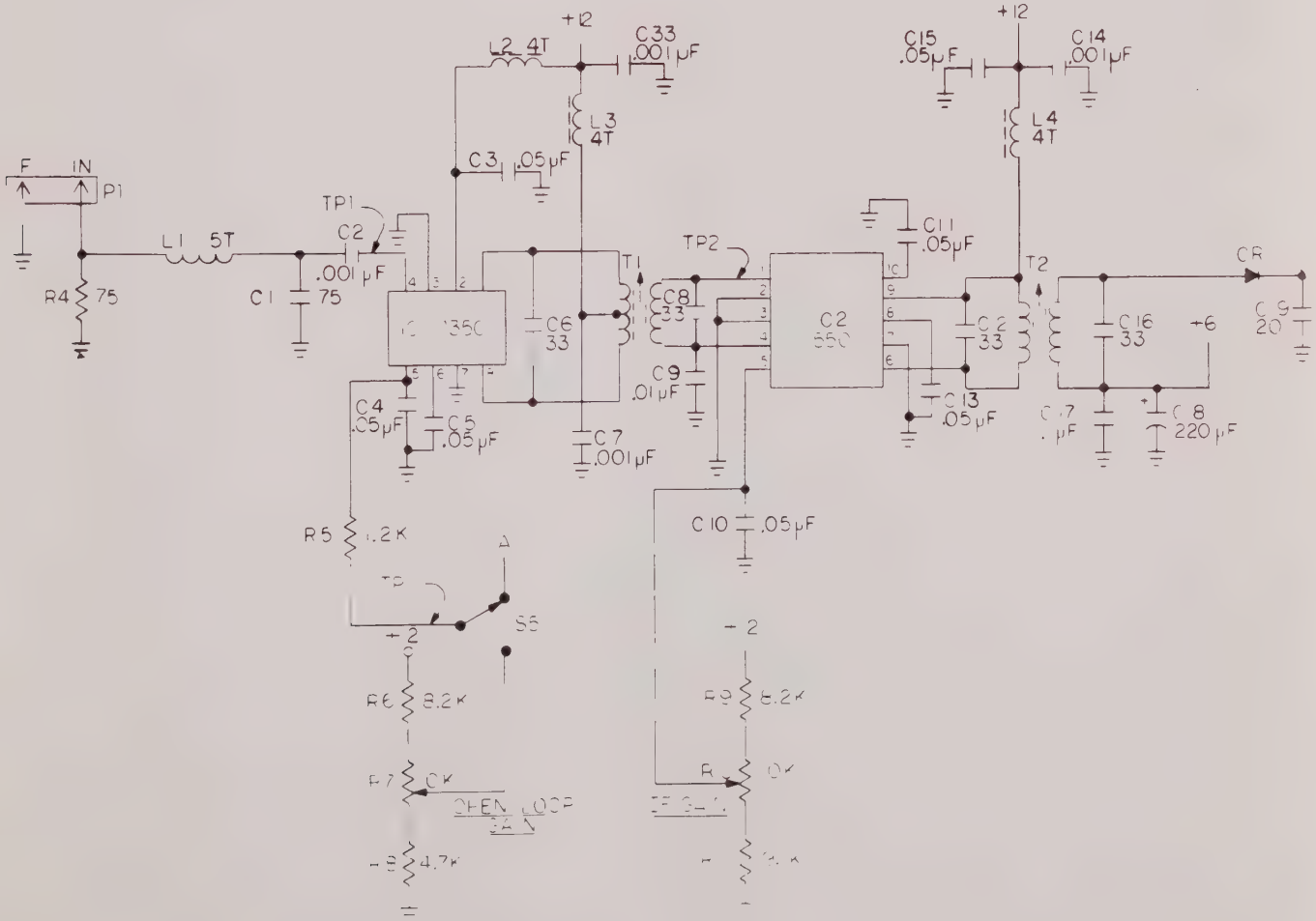
CHARGE CIRCUIT

The 16 volts is applied to the charge plug on the front panel, which is then rectified by CR5 and filtered by C29. Since this rectified voltage is higher than the battery voltage, current will flow through DS1 (which acts as a current limiter) and charges the battery.



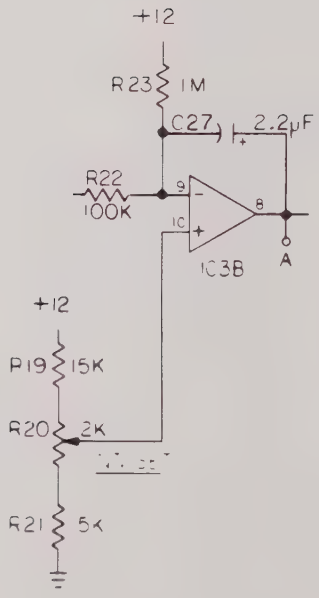
I.F.

The purpose of R4 is to provide a 75 ohm load to the R.F. L1 and C1 provide a low pass filter, which will pass 45.75 MHz and will reject any higher frequency. C2 couples the signal to the I.F. 1st amplifier, IC1, IC1 is capable of 60 dB of gain and has an AGC range of 60 dB. The output of the 1350 is tuned to 45.75 MHz by the primary of T1 and C6. The signal is then coupled into the secondary of T1, which is tuned to 45.75 MHz using C8. The signal is then amplified by approximately 30 dB of gain through IC2. The amount of gain is controlled by R10. The signal is then coupled across T2, which is also tuned to 45.75 MHz. C17 provides a signal ground to one side of the secondary of T2 and allows the full output signal to be seen across the secondary of T2. CR1 and C19 provide the 1st (R.F.) detector. At this 1st detector point there isn't any R.F. present, however there is some modulation.



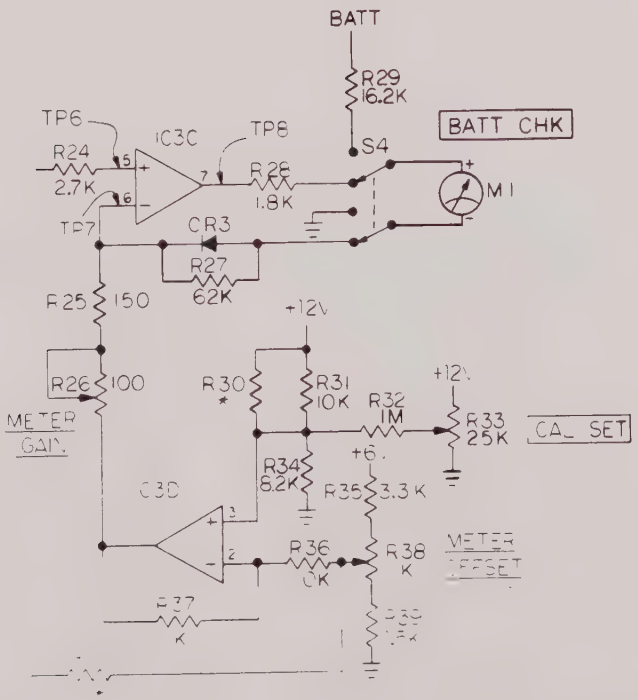
INTEGRATOR

The integrator is a comparator used to supply the AGC voltage. A reference voltage is set up on pin 10 of IC3B, which is controlled by R20. When a strong IF signal is applied to the IF input, the voltage on pin 9 decreases. As this voltage decreases, the voltage on pin 8 increases. The voltage is then applied back to pin 5 of IC1, which in turn decreases the gain of the 1350. This AGC loop maintains a constant signal level through the IF. The purpose of C27 is to slow the comparator to prevent oscillations.



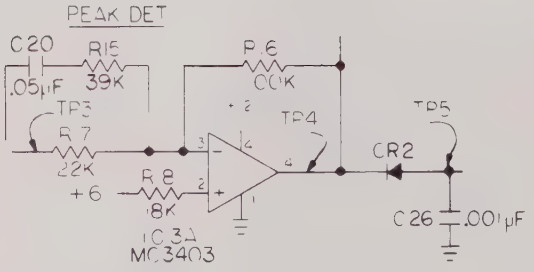
METER CIRCUIT

The meter circuit is driven by the AGC voltage rather than the detected IF. The purpose of IC3D is to provide a reference voltage to be compared with the AGC voltage. The main reference is set up by R30, R31,and R34. The R33 will provide a small amount of deviation to this main reference voltage. An offset is provided by R3 R38, and R39, which is used to calibrate the low end of the meter. IC3C is a voltage to current converter. As the voltage increases on pin 5 above the voltage on pin 6, the voltage on pin 7 also increases. This voltage at pin 7 will cause current to flow through the meter and through CR3, CR3 is forward biased and therefore allows the current to flow back through R25 to IC3D. Since the amount of gain is determined by the feedback resistance divided by the input resistance, the gain can be varied by the input resistance of R26. R26 is used to calibrate the high end of the meter. The meter can be switched by S4 through R29 for a battery indication on the meter movement.



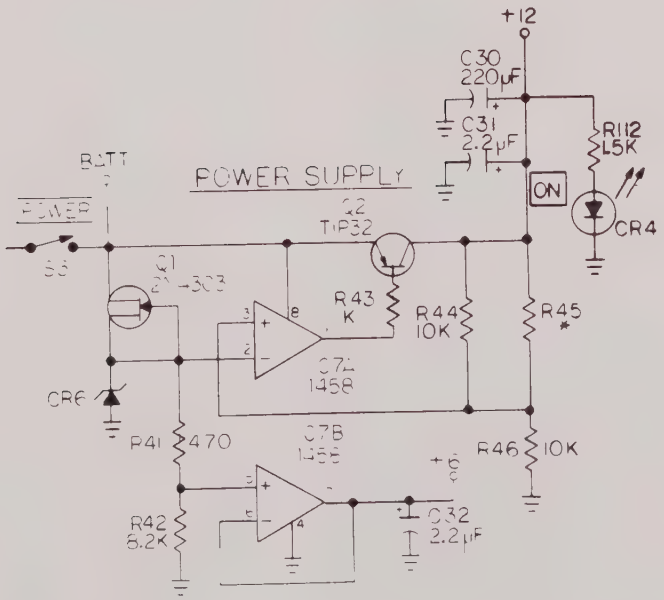
PEAK DETECTOR

The detected output from the IF is amplified by IC3A and is fed to a peak detector of CR2 and C26. The purpose of this detector circuit is to charge up C26 to the peak value of the modulation. All signal level meters measure peak value not average or RMS values. No detector is perfect and since C26 will discharge a certain amount, this voltage will still not be an absolute peak value. The purpose of C20 and R15 is to boost the gain of IC3A a small amount when video modulation is present.



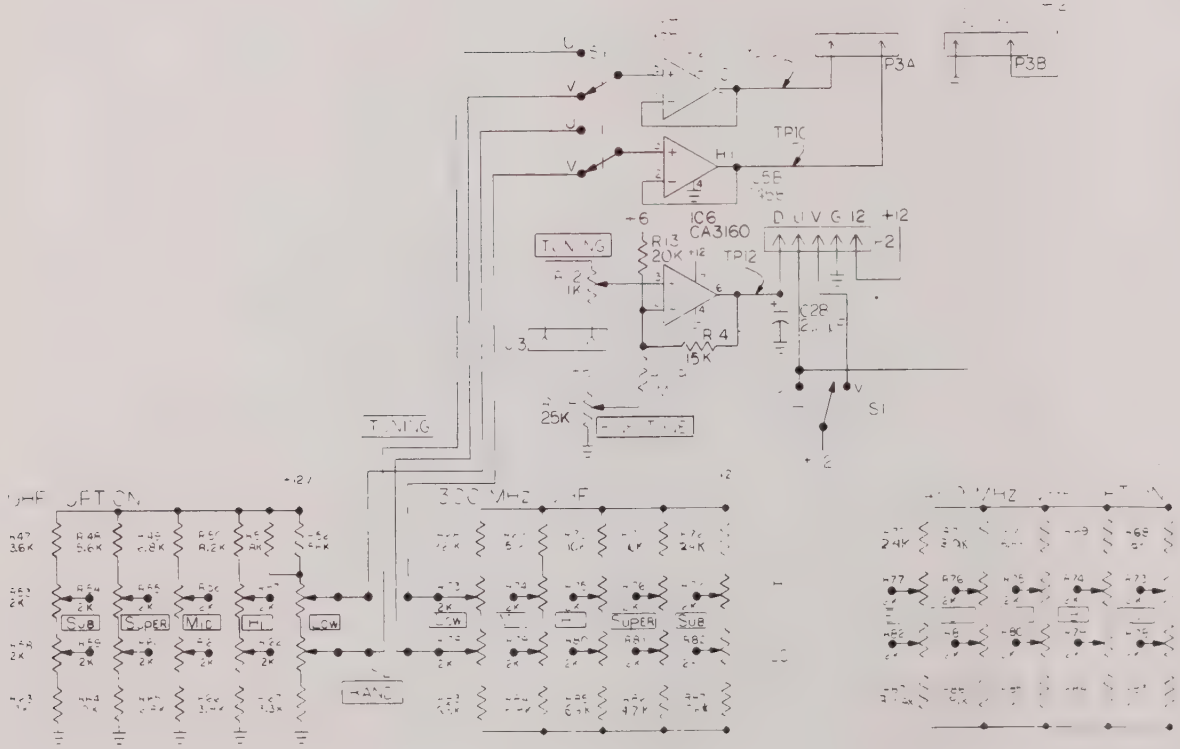
POWER SUPPLY

Q1 supplies a constant current source for zener diode CR6. CR6 provides a 6.2 V reference, which goes to a voltage divider of R41 and R42. This 6.2 V reference is buffered by IC7B. The 6.2 V reference is applied to the inverting pin of comparator IC7A. When power is first applied, the output on pin 1 of IC7A will be high, which causes Q2 to conduct very slightly. This allows only a small voltage to be seen on the output of the supply. The supply voltage is applied to a voltage divider of R44, R45, and R46. The voltage divider cuts voltage approximately in half. This voltage is applied to the non-inverting pin of IC7A. Since this voltage is lower than the voltage on pin 2, the output on pin 1 will decrease, Q2 conducts harder, which supplies a higher supply voltage. The supply voltage is regulated by comparing the values of the two input voltages of IC7A. R45 is chosen to result in a 12 V reference.



TUNING CIRCUIT

This circuit consists of a series of voltage divider networks, which can be switched between bands by S2. The two voltages, which are selected by S2 and applied to pin 3 of IC5B and pin 5 of IC5A, are buffered through the 1458 to provide isolation. These two outputs are then applied to R12. The wiper of R12 is tied to the non-inverting port of IC6. This voltage is amplified by IC6 and then supplied to the RF assembly (1st L.O.). R108 and R109 allow for a small change in the output voltage.



SAM JR. MAINBOARD PRELIMINARY CALIBRATION

I. Check and set up of the power supplies.
   1) 6 V line.
      a) Check at pin 7 of IC7B-1458.
      b) Should be between 5.8 V to 6.0 V.

   2) a) Check 12 V line the collector of Q2-TIP32
      b) It should be between 12 V to 12.1 V
      (R45 is typically around a 100 K ohm resistor)

II. Varactor Drive
   1) The tuning dial connector should be on the white connector
      a) One side will be ground.
      b) The other side will be approximately 0-12 V.

   2) While tuning through the course tune range you should have at least 11.8 V on one end of the dial and no less then .03 at the other end of the dial.

III. IF Alignment - 45.75 MHz
   1) Place the open/closed loop switch in open loop position (the switch should be towards the outside of the meter).
      a) Inject a 45.75 MHz signal at P1
      b) Connect the scope probe to the cathode of CR1 and place the can covers over T1 and T2.
      c) Peak slugs of T1 and T2 and adjust R7 (open loop gain control) to have a 1 V signal at 45.75 MHz.

   2) T1 primary side(which is the bottom of the coil form)
      will adjust the frequency response.
      secondary side(which is the top of the coil form)
      will adjust the amplitude response.

   3) T2 primary side(which is the bottom of the coil form)
      will adjust the amplitude response.
      secondary side(which is the top of the coil form)
      will adjust the frequency response.

   4) The base of the signal should be as narrow as possible with no shelf.

   5) Remove the can covers and slightly Q-dope the coils.

   6) Replace the covers and solder them onto the mainboard.
      NOTE: YOU MIGHT NEED TO SLIGHTLY REPEAK T1 AND T2.

IV. Integrator Alignment
   1) Open/closed loop switch should be in closed loop position.

   2) Connect your scope probe to TP4 which is pin 14 of IC3. Your generator needs to be manually tuned to 45.75 MHz.

   3) You should have approximately 3 V of gain from the 1 V signal in step Ic of section III.

4) Adjust integrator potentiometer R20 for .8 V signal.

V. Meter Tracking Alignment

1) This alignment is also done in closed loop

2) Set IF gain R10, calibration set pot R33, meter offset R38, and meter gain R26 to the middle of their range.

3) Connect your generator to P1 and adjust for 45.75 MHz signal at 20 dB.

4) Install *R30 to lower the meter reading to mid scale (typically R30 is around an 82K ohm resistor).

5) a) The offset potentiometer will be the low end meter adjustment control.
b) The meter gain potentiometer will be the high end meter adjustment control.

6) Adjust gain pot R26 to obtain 40 dB on the meter.

7) Set the generator for 10 dB output and adjust offset pot for 10 dB on the meter.

8) After steps 5 and 6 are balanced out (they will interact) check the 20 dB and 30 dB points, they should be within .5 dB.

VI. Peak Detector

1) Connect an MC50 to the RF input os the Sam and peak on a signal. Press the modulation switch of the MC50, the needle of the meter should drop. Select a resistor and complete the circuit at position R20. Change the value of this resistor (27K ohm ±10K ohm) until a needle drop of nomore than .2 dB is achieved.

VII. Audio

1) Turn audio potentiometer for full volume and listen for noise.

VIII. Charge Circuit

1) Plug AC charge cord onto 110 vac and connect to the unit. Connect a dummy battery of 18 V in place of a battery or power source.

2) Turn unit on. The "ON" lamp and the lamp on the mainboard should light. Turn unit off and charge lamps should dim.

IX. Battery Check

1) Apply 12.5 V to battery plug and push the battery check switch. A three-quarter scale deflection should be seen.

SAM JR. MAIN BOARD IC VOLTAGES

OPEN LOOP

IC1 -1350	IC2 -1550	IC3 -3403
1) 12	1) .8	1) 6.2
2) 12	2) 0	2) 5.9
3) 0	3) 0	3) 5.9
4) 14.1	4) .8	4) 12.
5) 6.1	5) 4.8	5) 3.2
6) 4.1	6) 12	6) 6.2
7) 0	7) 0	7) .7
8) 12	8) 6.3	8) 3.2
	9) 12	9) 6.
	10) 6	10) 5.9
		11) 0.
		12) 5.9
		13) 6.
		14) 5.9

IC4 -380	*IC5 -1458
1) .3	1) 7.3
2) .03	2) 7.3
3) 0	3) 7.2
4) 0	4) 0
5) 0	5) 8.2
6) 7.4	6) 8.6
7) 14.2	7) 8.6
8) 6.9	8) 12

*IC6 -3160	*IC7 -1458
1) .1	1) 13.4
2) 8.2	2) 6.3
3) 8.2	3) 6.3
4) 0	4) 0
5) .1	5) 6.
6) 10.6	6) 6.
7) 12	7) 6.
8) 4.6	8) Battery Voltage

*Depends on which band your on(these are average voltages).

NOTE: ALL VOLTAGES ARE APPROXIMATE

SAM JR. MAIN BOARD IC VOLTAGES

CLOSED LOOP

IC1 -1350	IC2 -1550	IC3 -3403
1) 12	1) .8	1) 6.
2) 12	2) 0	2) 5.7
3) 0	3) 0	3) 5.7
4) 4	4) .8	4) 12.
5) 6	5) 6.8	5) 0.
6) 4	6) 12	6) 6.1
7) 0	7) 0	7) 7.5
8) 12	8) 6.4	8) 6.1
	9) 12	9) 5.9
	10) 6.4	10) 5.9
		11) 0.
		12) 5.8
		13) 5.8
		14) 4.9

IC4 -380	*IC5-1458
1) 0	1) 3.5
2) .01	2) 3.5
3) 0	3) 3.5
4) 0	4) 0
5) 0	5) 4.6
6) 7	6) 4.6
7) 13	7) 4.6
8) 6.8	8) 12

*IC6 -3160	*IC7-1458
1) .08	1) 14
2) 4	2) 6.3
3) 4	3) 6.3
4) 0	4) 0
5) .08	5) 6.8
6) 2.9	6) 6.8
7) 12	7) 6.8
8 5.9	8) Battery Voltage

*Depends on which band your on(these are average voltages).

NOTE: ALL VOLTAGES ARE APPROXIMATE

SAM JR. UNIT CALIBRATION PROCEDURE

I Power Supplies

1) Check +6 VDC and +12 VDC power supplies. Should be ± .1 VDC.
    a. Changing the value of R45 will adjust the + VDC supply.

II IF

1) Connect the power cord to an external power supply.
2) Place connector P3B into the 6V position-this connector should be closest to the attenuator.
3) Connect the 1801 RF out to the "IF In" (P1) at 45.75 MHz. Check the 45.75 MHz shape.
4) Connect the "Demod In" on the 1801 to the cathode of CR1 on the Sam.
5) Set S5 to the open-loop position.
6) Set the 45.75 MHz signal to a reference voltage of 1 V, with the open-loop gain pot, (R7)
7) Disconnect the RF Out cable.

III 2nd L.O.

1) Connect a cable from a frequency counter to the "F" connector on the bottom of the RF assembly. This is located near the right hand corner of the R.F.
2) The 2nd L.O. frequency should be 414.25 MHz for all newer units, and 354.25 MHz for the older units and most 300 MHz units.

IV. R.F. Gain, Flatness, and Sweep Width

1) Connect an I.F. cable from an 1801 sweep generator, (R.F. Out to the I.F. In on the mainboard of the Sam).
    a. The generator should be set for an output of +20 dB at 45.75 MHz.
    b. Connect a cable from the Demod In to Video Vert. on the front panel.
    c. Place the unit in open-loop (S5 on the mainboard).
    d. Set the scope for an X-Y display with the horizontal output of the generator to the horizontal amp of the scope.
    e. Connect the Vertical Output of the generator to the vertical amp of the scope.
    f. Set the scope to .2 V per division(DC coupled).
    g. Set the generator to 100 msec. sweep, with sweep time and sweep width for approximately 80 MHz.
    h. Adjust R7 (open loop gain) for a signal approximately 1 V.

2) Disconnect I.F. cable from the sweep generator and replace it with the I.F. cable from the R.F. assembly.
   a. Connect the R.F. out cable from the generator to the R.F. in connector on the Sam.
   b. Place the Sam attenuator to read a +20 dBmV reading.
   c. Tune the generator to 150 MHz at +20 dBmV.
   d. Tune the Sam to 150 MHz. Observe the signal.
   e. Peak all tuning caps and coils on the R.F. assembly, starting with the one at the left front of the R.F.
   f. Tune the coil on the bottom of the R.F. for a peak signal. You should be observing an R.F. signal approximately 36 to 40 dBmV.
   g. Adjust R7 again 1 V signal. This finishes the R.F. gain check.

3) To check the flatness use your reference voltage of 1 V.
   a. Start by tuning the Sam and the sweep generator together down in frequency. Watch the scope and observe the amplitude, it shouldn't change more then ±.7 dBmV from 10 MHz to the top range of your meter.
   b. Observe the sweep to also insure that the sweep width goes down to -10 to -12 MHz and up past the top range of your meter plus about 12 MHz.

4) UHF Calibration
   a. Check UHF Flatness by first switching the Sam into UHF. Connect the 1801 sweeper to the RF input of the Sam. Set a 1 V refference at 471 MHz, sweep up to 890 MHz. The signal cannot very more than +3 dB.
   b. The flatness characteristics of the UHF L.O. are very different than that of the VHF L.O. therefore in some cases a UHF meter compensation resistor is needed. With the unit in closed loop peak up on a 150 MHz +20 dB signal from a MC50.
   c. Use the calibration set pot to set the meter right at 20 dB. Remove the MC50 and connect the 1801 sweeper to the Sam.
   d. With the 1801 in manual sweep to 150 MHz and set the variable attenuator of the 1801 so that the Sam meter reads exactly 20 dB. Switch the Sam into UHF and using the 1801 find the highest meter reading and the lowest meter reading between 471 MHz and 890 MHz. If these readings are within ±1.5 dB of the 20 dB reference, no compensation resistor is needed. If however the lowest UHF reading is not within 1.5 dB of 20 dB select a resistor of 1 M and place it in position R80. Repeat the above steps, being sure to reset the 150 MHz 20 dB reference. If the lowest UHF reading is still not within 1.5 dB of 20 dB, reduce the value of resistor R80. Make sure you check the highest UHF reading to see that it is not more than 1.5 dB greater than 20 dB. If you are unable to get the UHF readings within ±1.5 dB of 20 dB, the UHF L.O. board requires work and must be sent to the factory for repair.

V. Dial Tracking

1) Connect the R.F. cable to P1 on the mainboard.
2) Place the wide range connector to P3A position.
3) Place the band switch to the Sub band position.
4) Adjust the 1801's sweep width and frequency to get a 10-50 MHz sweep.
5) Place the course tune potentiometer (R12) to 10 MHz and center the fine tune potentiometer (R108).
6) Adjust R77 to read 10 MHz.
7) Place R12 (course tuning potentiometer) to 50 MHz.
8) Adjust R82 to read 50 MHz.
9) Repeat steps 5-8, these adjustments will interact.
10) Adjust the frequency and sweep width on the 1801 to get a 50-110 MHz sweep.
11) Place the band switch to the Low band position.
12) Place the course tune to 50 MHz on the Sam.
13) Adjust R73 to read 50 MHz.
14) Place R12 (course tuning potentiometer) to 110 MHz.
15) Adjust R78 to read 110 MHz.
16) Repeat steps 12-15, these adjustments will interact.
17) Continue dial tracking unit as follows. Set the 1801's sweep width and frequency to sweep throught the particular band your set on.
18) Adjust the corresponding potentiometers on the main board depending on which end of the band you have the course tuning control set on.
19) Once the end point of the frequency dial has been set once, repeat again, they will interact.
20) Use the frequenies in Fig. below for UHF dial tracking. First set the end points of band a using an 1801 sweeper and scope. After the end points are set, check each UHF frequency. They must be within ±6 MHz. Repeat these steps for the remaining bands.

VHF FREQUENCIES

BAND	LOW FREQ.	POT. #	HIGH FREQ.	POT. #
A	50 MHz	1	132 MHz	7
B	132 MHz	2	210 MHz	8
C	210 MHz	3	288 MHz	9
D	288 MHz	4	372 MHz	10
E	372 MHz	5	450 MHz	11
Sub.	10 MHz	6	50 MHz	12

UHF FREQUENCIES

BAND	LOW FREQ.	MID FREQ.	HIGH FREQ.
A	471 MHz	513 MHz	555
B	555 MHz	597 MHz	639
C	639 MHz	681 MHz	723
D	723 MHz	765 MHz	807
E	807 MHz	849 MHz	891

VI INTEGRATOR

1) Tune the Sam and the MC-50 to 150.0 MHz at +20 dBmV.
2) Connect the scope probe to test point 4, pin 14 of IC3.
3) Put in closed-loop and place the sweeper in manual sweep mode. Sweep through from no signal to a maximum signal. The maximum signal condition should lower the response by .8V, adjust R20 for a .8 V difference.

VII METER TRACKING

1) Place S5 in closed loop position and the band switch to Mid band position.
2) Center the calibration set control (R33) to mid position.
3) Place 2 attenuator pads in for a 40 dB of attenuation.
4) Connect a 20 dB signal at 150.0 MHz to the R.F. in on the front panel.
5) Peak on the signal with the course tune adjust on the Sam (R12).
6) Insert R30. It is typically a value between 47-82K, to get as close to 20 dB reading as possible.
7) Adjust the offset potentiometer (R38) for a 20 dB reading.
8) Remove one attenuator pad for 20 dB of attenuation.
9) Adjust R26 for a 0 dB reading.
10) Place two attenuator pads back in for 40 dB of attenuation.
11) Adjust R38 for a 20 dB reading.
12) Continue to adjust R38 for 20 dB reading and R26 for a 0 dB reading until meter tracking is linear.

VIII PEAK DETECTOR

1) R15 is approximately 22K to 39K ohm resistor.
2) Connect your MC-50 Out to the Sam R.F. In.
3) Tune your MC-50 to 150 MHz at +20 dBmV.
4) Tune the Sam to 150 MHz and peak on the signal.
5) Turn TV modulation on, and the signal on the Sam should read +19.75 dBmv to +20 dBmV. If you do not have the reading in this window of range, change the value of R15.

IX SPURS

1) Place all attenuator pads out, for no attenuation.
2) Tune the Sam from 4.0 MHz (or the lowest frequency your meter is speced)to for the highest frequency of your meter. You shouldn't see any meter deflection.

X CHARGING CIRCUIT

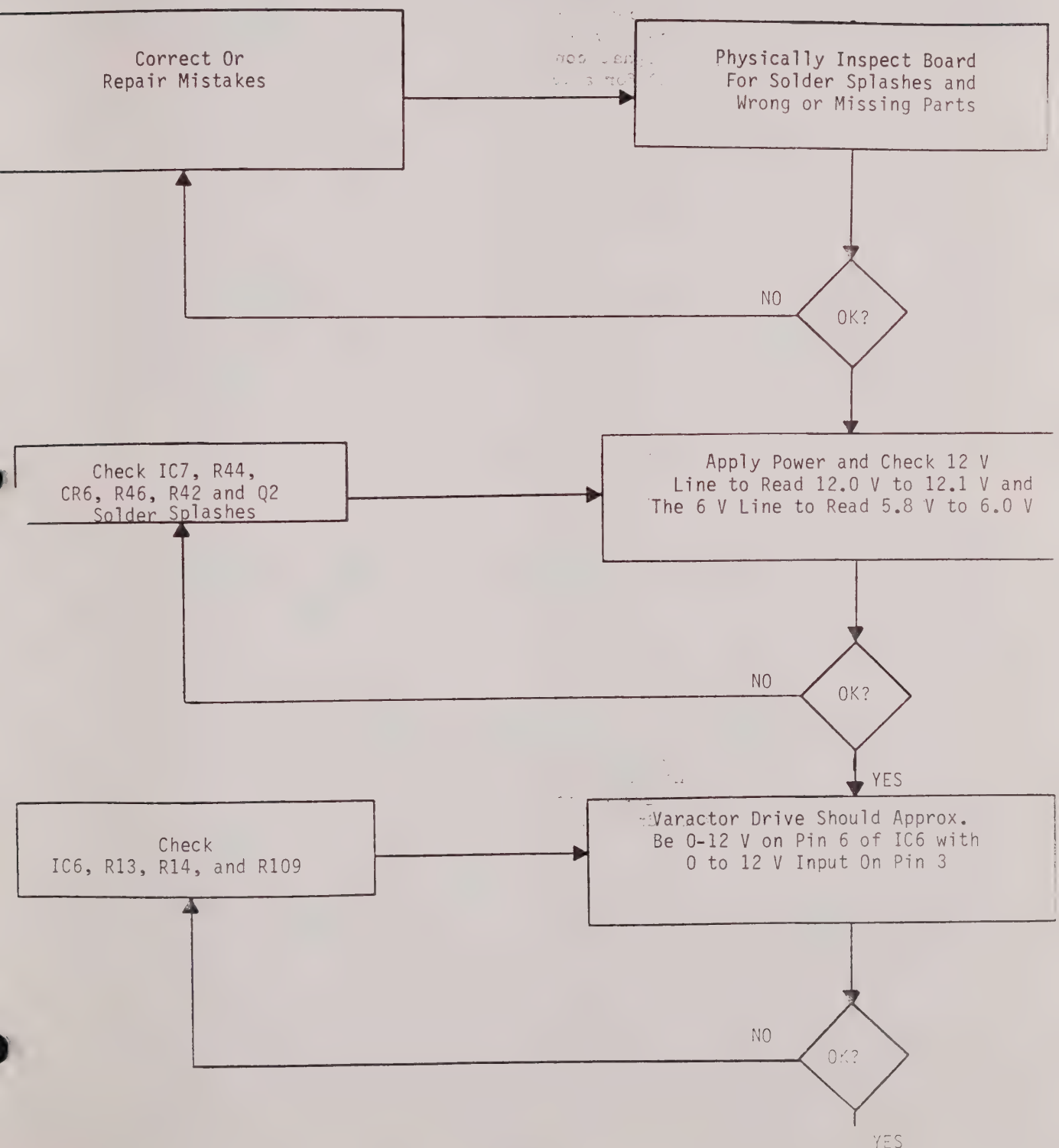
1) With the Sam connected to an external power supply it will consume approximately 140 mA (this is with the volume turned fully on).
2) Plug in the AC charge transformer to the Sam. Observe the power supply. The current should drop to approximately 40 mA. At this time both the inside charge light and the front panel charge light should be aluminated.

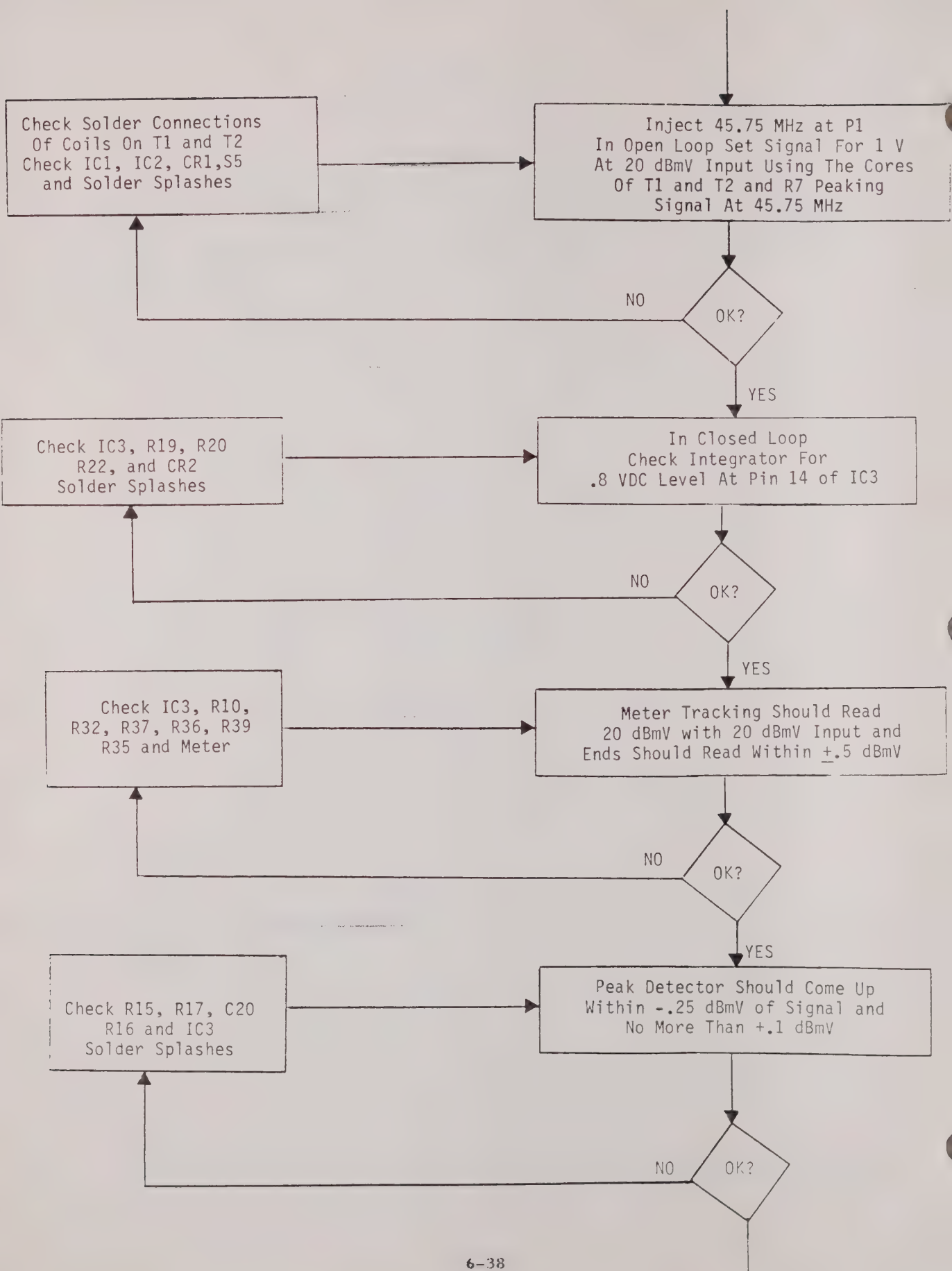
XI BATTERY CHECK

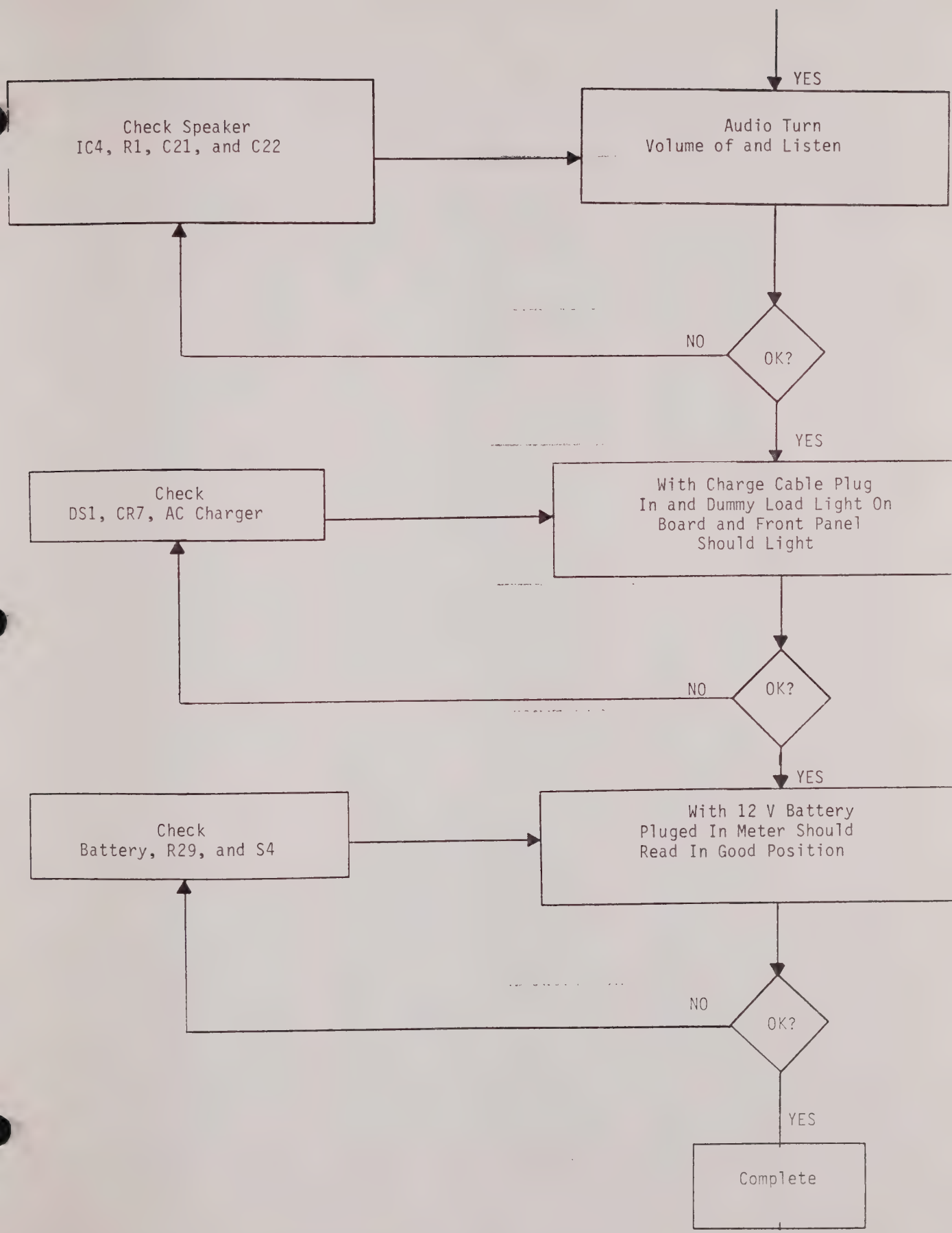
1) Apply 12.5 V to the battery plug and push the battery check switch. A three-quarter scale deflection should be seen.

SAM JR. MAIN BOARD

(Troubleshooting)




Check Solder Connections
Of Coils On T1 and T2
Check IC1, IC2, CR1,S5
and Solder Splashes
Inject 45.75 MHz at P1
In Open Loop Set Signal For 1 V
At 20 dBmV Input Using The Cores
Of T1 and T2 and R7 Peaking
Signal At 45.75 MHz
NO
OK?
YES
Check IC3, R19, R20
R22, and CR2
Solder Splashes
In Closed Loop
Check Integrator For
.8 VDC Level At Pin 14 of IC3
NO
OK?
YES
Check IC3, R10,
R32, R37, R36, R39
R35 and Meter
Meter Tracking Should Read
20 dBmV with 20 dBmV Input and
Ends Should Read Within ±.5 dBmV
NO
OK?
YES
Check R15, R17, C20
R16 and IC3
Solder Splashes
Peak Detector Should Come Up
Within -.25 dBmV of Signal and
No More Than +.1 dBmV
NO
OK?


YES
Check Speaker
IC4, R1, C21, and C22
Audio Turn
Volume of and Listen
NO
OK?
YES
Check
DS1, CR7, AC Charger
With Charge Cable Plug
In and Dummy Load Light On
Board and Front Panel
Should Light
NO
OK?
YES
Check
Battery, R29, and S4
With 12 V Battery
Pluged In Meter Should
Read In Good Position
NO
OK?
YES
Complete

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
0412-00-0001	ASY DWG, SAM 1ST L.O.	1.000
0412-10-0000	AY DWG, SAM JR	2.000
0414-10-0001	SCH, SAM 1ST L.O.	1.000
0414-30-0000	SCH, SAM JR	2.000
1110-00-0922	MAIN BD, SAM JR-UHF	1.000
1110-40-0021	PRELIM, SAM JR-UHF	1.000
1111-00-0116	CASE, SAM JR	1.000
1113-20-0056	ATTEN, 7560	1.000
1118-00-0075	FP ASSY, SAM JR-UHF	1.000
1118-40-0031	SAM JR UHF FINAL ASY	1.000
1210-43-0007	COIL, 19T, 24GA	1.000
1210-43-0009	RF XFMR	1.000
1210-43-0010	RF XFMR	1.000
1212-10-0001	SWITCH/NUT ASSY	3.000
1216-00-0021	CHAS, RF AY, UHF	1.000
1216-40-0005	FINAL ASSY PARTS KIT	1.000
1217-70-0071	CABLE ASSY, 6IN	1.000
1217-70-0079	CABLE ASSY, 7 IN	1.000
1218-00-0100	OSC BD, SAM II-UHF	1.000
1218-40-0000	SAM 1ST L.O. PC ASSY	1.000
1218-40-0018	SAM JR 450 MB FINAL	1.000
1219-00-0240	BATT ASSY, SAM JR	1.000
1219-00-0244	RF SUBAY 1-2, SAM-UHF	1.000
1219-00-0245	RF SUBAY 3-4, SAM-UHF	1.000
1219-00-0246	RF SUBAY 5-6, SAM-UHF	1.000
1219-00-0279	RF SUBAY 0, SAM-UHF	1.000
1219-00-0348	DIAL POT ASSY, SAM JR	1.000
1219-00-0375	MAIN BD FINAL,	1.000
1219-40-0010	HARNESS, SAMJR UHF RF	1.000
1219-40-0027	SAM JR SHIPPING KIT	1.000
1219-40-0056	JR MAIN BD COIL KIT	1.000
1219-40-0057	SAM JR WIRE KIT	1.000
1219-40-0060	SAM JR-UHF FP PTS KT	1.000
1410-01-1960	SPEAKER GRILL 2 X 2	1.000
1410-01-1970	IF CAN PER B/P	4.000
1410-01-2470	SPACER FOR SAM JR	1.000
1410-30-2220	SAM RF LID COVER PER	1.000
1410-30-2580	FISH PAPER, PER B/P	1.000
1410-30-2590	BATTERY HOLDER FOR	1.000
1410-80-0750	SAM RF METAL WORK	1.000
1410-80-0760	SAM JR. WRAP AROUND	1.000
1410-80-0770	SAM JR. FRONT PANEL	1.000
1411-11-2980	COVER FOR ATTN ENCL	1.000
1411-11-3010	BODY 75 OHM CABLE PER B/P	1.000
1411-11-3020	75 OHM "F" RECEPTALE PER B/P	1.000
1411-11-3030	INSULATOR BODY "F" PER B/P	1.000
1411-11-3040	R INSULATOR "F" REPT	1.000
1411-11-3050	FT INSULATOR "F"RCPT	1.000
1411-11-3650	ENCLOSURE	1.000
1411-11-3660	SHIELD-INTER	3.000
1411-11-3670	SHIELD-INTRA	1.000
1414-00-1002	COPPER TAPE 1610-02-0002	1.000
1414-00-1013	BATTERY SUPPORTS	2.000
1510-00-1102	CAP, CHIP, 1000PF, 50V	7.000
1510-00-2750	CAP., CHIP 75PF 10%	1.000
1510-00-5470	CAP, CHIP, 47PF	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
1510-00-7501	CAP,CHIP,500	1.000
1510-00-8569	CAP,CHIP,5.6	2.000
1510-00-9102	CAP,CHIP,1000	6.000
1510-10-0100	CAP,DISC,1KV,10PF	2.000
1510-10-0109	CAP,DISC,1KV,1PF	2.000
1510-10-0200	CAP,DISC,1KV,20PF	1.000
1510-10-0202	CAP,DISC,1KV,2PF	1.000
1510-10-0309	CAP,DISC,1KV,3PF	1.000
1510-10-0330	CAP,DISC,1KV,33PF	4.000
1510-10-0409	CAP,DISC,1KV,4PF	1.000
1510-10-0500	CAP,DISC,1KV,50PF	1.000
1510-10-0609	CAP,DISC,1KV,6PF	1.000
1510-10-0750	CAP,DISC,1KV,75PF	1.000
1510-10-1302	CAP,DISC,1KV,.003UF	1.000
1510-10-3229	CAP,DISC,1KV,2.2PF	1.000
1510-10-7471	CAP,DISC,50V,470PF	3.000
1510-12-1102	CAP,DISC,1000PF	12.000
1510-12-2103	CAP,DISC,80/20,.01MF	1.000
1510-12-2104	CAP,DISC,80/20,.1MF	4.000
1510-12-2503	CAP,DISC,80/20,.05MF	8.000
1510-14-4103	CAP,MON,50V,.01UF	1.000
1510-23-4101	CAP,ELEC,25V,100UF	2.000
1510-23-5221	CAP,ELEC,16V,220UF	2.000
1510-23-9221	CAP,ELEC,16V,220UF	1.000
1510-23-9222	CAP,ELEC,16V,2200UF	1.000
1510-24-0229	CAP,TANT,25V,2.2UF	6.000
1510-31-8501	CAP,FT,500PF	9.000
1510-40-0139	CAP,COMP,500V,1.3PF	3.000
1510-40-1518	CAP,COMP,500V,.51PF	1.000
1510-70-1030	CAP,VAR,.5-3PF	1.000
1510-71-2859	CAP,VAR,.8-8.5PF	2.000
1510-71-3100	CAP,VAR,10PF	2.000
1610-02-0002	TAPE,COPPER,1/4", (18YDS.PER RL)	1.840
1710-00-2310	PC BOARD, 080-060C FROM:3210-05-0045	1.000
1710-00-2360	PC BOARD, 080-048B	1.000
1714-00-0000	SAM IST L.O. PCB FROM:3210-05-0046	1.000
1810-03-0278	CHOKE,COATED,.27UH	2.000
1810-05-0003	TOROID,4T,1-1/4L	3.000
1810-06-0003	COIL,TAPPED,1:1-1/2	1.000
1810-06-0004	COIL,TAPPED,1:4	1.000
1810-10-0189	CHOKE,MOLDED,1.8 UH	3.000
1813-00-0007	FERR. BEAD,LC000-009	6.000
1813-00-0033	COIL FORM	2.000
1813-00-0036	SLUG CORE	4.000
1813-00-0038	COIL MNTG. BASE	2.000
1813-00-0039	COILFORM	1.000
1813-00-0052	FERRITE SLEEVE	1.000
1813-00-0053	BALUN CORE	1.000
1815-00-0017	COIL,4-1/2T.#22	1.000
2110-06-0001	CONN.,F	1.000
2110-06-0004	ADPTR,F-F,F-F,.80	1.000
2110-06-1005	CONN,F,W/HDWR	2.000
2112-03-0025	TERM,LCKNG,NO 10	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
2112-05-0006	CONN., MALE, 5-PIN	1.000
2112-05-0010	CONN., MALE, 2-PIN	3.000
2112-12-0005	PHONO JACK	1.000
2112-12-0006	PLUG, PHONO, LONG	1.000
2112-32-0003	PLUG, BATTERY, 10-12IN	3.000
2112-32-0008	RECEPT., DC	1.000
2113-06-0008	JACK, FEMALE, 5-CKT	1.000
2113-06-0014	CONN, FEMALE, 2-PIN	2.000
2113-07-0001	CONTACT MC000-068	5.000
2113-07-0002	CONTACT, MC000-131	9.000
2410-01-0033	KNOB, 15/64-I.D.	1.000
2410-01-0034	KNOB, BLK, 1/8-IN	1.000
2410-01-0037	CAP, BLK, GLAMOUR	3.000
2410-01-0039	KNOB W/8-32 SET	1.000
2410-01-0042	KNOB, 3.5CLR DIAL	1.000
2410-02-0006	LAMP	1.000
2410-04-0001	DECAL, SER. NO.	2.000
2410-06-0010	1 MADC METER PER B/P	1.000
2414-04-0006	DECAL, BATT CHG, SAM	1.000
2414-24-0003	DECAL, SAM I-300-UHF	1.000
2810-00-0007	CABLE CLAMP, 3/16	1.000
2810-09-0014	NUT, PRESS, 4-40, .030	6.000
2810-10-0035	GROMMET, RBBR, 3/16	1.000
2810-12-0029	HOLDER, PER B/P	1.000
2810-15-0001	NUT, HEX, 3/8-32X1/2AF	2.000
2810-16-0019	NUT, HEX, 4-40X1/4X	4.000
2810-16-0020	NUT, DRESS, FLARED	3.000
2810-17-2103	SCW, SBH, 2-56X3/16	2.000
2810-17-4102	SCW, SBH, 4-40X1/8	8.000
2810-23-0031	SCREW, PAN HD, BLK,	6.000
2810-23-0034	SCREW, SWG, PAN, PHIL	19.000
2810-23-0037	SCW, SLT HEX WSHR HD	6.000
2810-23-0043	SCREW, PAN HD,	6.000
2810-24-4000	LO, WASHER, INT, 4	1.000
2810-25-4000	LWASHER, EXT, 4	4.000
2810-28-0003	LW, INT, SPEC, 3/8 ID	4.000
2810-28-0041	WASHER, FLAT	1.000
2810-28-0043	LOCKWASHER, INT, 1/4IN	2.000
2810-35-0003	HOLE PLUG, 1/4	1.000
3010-11-0004	1 3/4 IN SPEAKER	1.000
3010-54-0005	MIXER, DBL. BAL.	1.000
3210-05-0045	G-10FR, 1/16X10X12	0.500
3210-05-0046	G-10FR, 1/16X12X16	0.025
3210-12-0008	CASE, PLASTIC, 6X6X9"	1.000
4010-00-0012	BATT PAK 12-AA	1.000
4010-00-0019	BATTERY CHARGER, 16V	1.000
4610-01-4101	POT, 100	1.000
4610-01-4102	POT, 1K	1.000
4610-01-4103	POT, 10K	2.000
4610-01-4202	POT, 2K	21.000
4610-14-5102	POT, 1K	1.000
4610-14-6253	POT, 25K	1.000
4610-31-3103	POT, 10K, W/SW	1.000
4610-50-1253	POT, 25K	1.000
4700-05-1000	RES, C, 1/8W, 5%, 100	2.000
4700-05-1509	RES, C, 1/8W, 5%, 15	2.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4700-05-2000	RES,C,1/8W,5%,200	1.000
4700-05-3901	RES,C,1/8W,5%, 3.9K	1.000
4700-05-6800	RES,C,1/8W,5%,680	1.000
4700-15-1000	RES,C,1/4W,5%,100	1.000
4700-15-1001	RES,C,1/4W,5%,1K	7.000
4700-15-1002	RES,C,1/4W,5%,10K	8.000
4700-15-1003	RES,C,1/4W,5%,100K	3.000
4700-15-1004	RES,C,1/4W,5%,1M	3.000
4700-15-1009	RES,C,1/4W,5%,10	3.000
4700-15-1201	RES,C,1/4W,5%,1.2K	2.000
4700-15-1302	RES,C,1/4W,5%,13K	1.000
4700-15-1500	RES,C,1/4W,5%,150	1.000
4700-15-1501	RES,C,1/4W,5%,1.5K	3.000
4700-15-1502	RES,C,1/4W,5%,15K	3.000
4700-15-1801	RES,C,1/4W,5%,1.8K	1.000
4700-15-1802	RES,C,1/4W,5%,18K	2.000
4700-15-2002	RES,C,1/4W,5%,20K	2.000
4700-15-2201	RES,C,1/4W,5%,2.2K	1.000
4700-15-2202	RES,C,1/4W,5%,22K	2.000
4700-15-2402	RES,C,1/4W,5%,24K	1.000
4700-15-2701	RES,C,1/4W,5%,2.7K	2.000
4700-15-2708	RES,C,1/4W,5%,2.7	1.000
4700-15-3300	RES,C,1/4W,5%,330	1.000
4700-15-3301	RES,C,1/4W,5%,3.3K	2.000
4700-15-3601	RES,C,1/4W,5%,3.6K	1.000
4700-15-3901	RES,C,1/4W,5%,3.9K	1.000
4700-15-3902	RES,C,1/4W,5%,39K	1.000
4700-15-4700	RES,C,1/4W,5%,470	2.000
4700-15-4701	RES,C,1/4W,5%,4.7K	3.000
4700-15-4709	RES,C,1/4W,5%,47	1.000
4700-15-5601	RES,C,1/4W,5%,5.6K	3.000
4700-15-5602	RES,C,1/4W,5%,56K	1.000
4700-15-5609	RES,C,1/4W,5%,56	1.000
4700-15-6202	RES,C,1/4W,5%,62K	1.000
4700-15-6801	RES,C,1/4W,5%,6.8K	5.000
4700-15-7509	RES,C,1/4W,5%,75	1.000
4700-15-8201	RES,C,1/4W,5%,8.2K	5.000
4700-15-9101	RES,C,1/4W,5%,9.1K	1.000
4701-03-1622	RES,MF,1/8W,1%,16.2K	1.000
4705-05-1000	RES,C,1/8W,5%,100	1.000
4705-05-1002	RES,C,1/8W,5%,10K	2.000
4705-05-1209	RES,C,1/8W,5%,12	2.000
4705-05-1509	RES,C,1/8W,5%,15	1.000
4705-05-2200	RES,C,1/8W,5%,220	1.000
4705-05-2202	RES,C,1/8W,5%,22K	3.000
4705-05-2700	RES,C,1/8W,5%,270	1.000
4705-05-3000	RES,C,1/8W,5%,300	2.000
4705-05-3900	RES,C,1/8W,5%,390	2.000
4705-05-4301	RES,C,1/8W,5%,4.3K	1.000
4705-05-9101	RES,C,1/8W,5%,9.1K	1.000
4705-15-3301	RES,C,1/4W,5%,3.3K	1.000
4741-37-4008	RES,L-A,1/4W,1%,374	3.000
4741-90-9007	RES,L-A,1/4W,1%,90.9	6.000
4799-99-9999	RES,VAL DET IN CALIB	3.000
4801-01-0825	DIODE,ZENER,6.2V	1.000
4803-02-0011	DIODE,VARACTOR	4.000

-PART USED-	PART DESCRIPTION.....	QUANTITY REQUIRED
4803-02-0020	DIODE, VARACTOR	2.000
4806-01-4007	DIODE,RECT,1000V	1.000
4807-01-0034	DIODE,GE PT CONTACT	1.000
4807-01-0914	DIODE,SIGNAL	3.000
4810-02-0007	LED,RD,W/BEZEL	2.000
4901-04-3030	TRANSISTOR	1.000
4901-04-4160	JFET,N-CHANNEL	1.000
4901-05-1791	TRANSISTOR,NPN,	3.000
4902-00-0320	TRANSISTOR,POWER	1.000
4902-00-0901	TRANSISTOR, MOT ONLY	1.000
4902-00-0911	TRANSISTOR, MOT ONLY	1.000
4902-00-9110	TRANSISTOR,RF	1.000
4902-04-0490	TRANSISTOR,PNP	1.000
4999-00-0007	TRANSISTOR	1.000
5104-00-0034	SWITCH,ROTARY	1.000
5105-00-0016	SWITCH,SLIDE,DPDT	3.000
5105-00-0017	SWITCH,SLIDE	1.000
5106-00-0020	SWITCH,TOGGLE	1.000
5106-00-0025	SWITCH,3PDT	1.000
5199-00-9999	SWITCH,P/O POT ASSY	1.000
6010-72-4000	WIRE,MAGNET,24GA.	52.000
	WIRE,MAGNET,24GA.	
6010-72-8000	WIRE,MAGNET,28GA.	0.600
6010-73-2000	WIRE,MGNT,32GA,GN	4.000
6010-73-4000	MAGNET WIRE,34 GA.,	0.330
6010-91-4000	WIRE,BUS,14 GA	2.500
6010-91-8000	WIRE,BUSS,18 GA.	10.000
6010-92-2000	WIRE,BUSS,22GA.	4.000
6011-20-2000	SLEEVING,SHRINKABLE,	0.500
6011-40-0001	CABLE,SUBMINAX,75	6.500
6011-40-0008	CABLE, RG174/U,	6.750
6011-40-0012	CABLE,59/U,DBL SHLD	7.000
6012-12-2000	WIRE,22,BK	11.000
6012-12-2222	WIRE,22,RD	7.000
6012-12-2444	WIRE,22,YL	6.000
6012-12-2555	WIRE,22,GN	7.750
6012-12-2777	WIRE,22,VI	4.000
6012-12-2888	WIRE,22,GY	10.000
6012-12-2889	WIRE,22,GY/WH	8.000
6012-12-2991	WIRE,22,WH/BN	6.000
6012-12-2993	WIRE,22,WH/OR	7.500
6012-12-2994	WIRE,22,WH/YL	5.000
6012-12-2996	WIRE,22,WH/BL	8.000
6012-12-2997	WIRE,22,WH/VI	4.000
6012-12-2998	WIRE,22,WH/GY	4.000
6012-12-2999	WIRE,22,WH WIRE,22,WH	45.750
6012-52-4000	WIRE,MAGNET,24GA.	2.000
6014-41-9000	WIRE,HALF-HARD BRASS	0.001
	WIRE,HALF-HARD BRASS	
6510-00-0035	HANDBOOK,SAM SER	1.000
7000-03-8000	AUDIO POWER AMP	1.000
7000-13-5000	IF AMP	1.000
7000-14-5801	DUAL OP AMP,MOT	2.000
7000-15-5000	HI FREQ AMP	1.000
7000-31-6000	WIDE-BAND OP AMP	1.000
7000-34-0300	QUAD OP AMP	1.000

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